

EMC^a

energy market consulting associates

Transgrid Contingent Project Application (CPA)

REVIEW OF ASPECTS OF THE CPA FOR HUMELINK STAGE 1 (EARLY WORKS): PUBLIC VERSION



Report prepared for:
**AUSTRALIAN ENERGY
REGULATOR**
July 2022

Preface

This report has been prepared to assist the Australian Energy Regulator (AER) with its determination of the appropriate revenues to be applied to the prescribed transmission services of TransGrid from 1st July 2023 to 30th June 2028. The AER's determination is conducted in accordance with its responsibilities under the National Electricity Rules (NER).

This report covers a particular and limited scope as defined by the AER and should not be read as a comprehensive assessment of proposed expenditure that has been conducted making use of all available assessment methods. This report relies on information provided to EMCA by Transgrid and other parties. EMCA disclaims liability for any errors or omissions, for the validity of information provided to EMCA by other parties, for the use of any information in this report by any party other than the AER and for the use of this report for any purpose other than the intended purpose. In particular, this report is not intended to be used to support business cases or business investment decisions nor is this report intended to be read as an interpretation of the application of the NER or other legal instruments.

EMCA's opinions in this report include considerations of materiality to the requirements of the AER and opinions stated or inferred in this report should be read in relation to this over-arching purpose.

Except where specifically noted, this report was prepared based on information provided by AER staff prior to 30th June 2022 and any information provided subsequent to this time may not have been taken into account. Some numbers in this report may differ from those shown in Transgrid's regulatory submission or other documents due to rounding.

Enquiries about this report should be directed to:

Paul Sell

Managing Director
+61 (0)412 559 138
psell@emca.com.au

Prepared by

Paul Sell and Gavin Forrest, with input from Mark de Laeter and analysis from Eddie Syadan

Date saved

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Energy Market Consulting associates

ABN 75 102 418 020

Sydney Office

L32, 101 Miller Street, North Sydney NSW 2060
PO Box 592, North Sydney NSW 2059
+(61) 2 8923 2599
contact@emca.com.au
www.emca.com.au

Perth Office

Level 1, 2 Mill Street, Perth WA 6000
+(61) 8 9421 1704
contact@emca.com.au
www.emca.com.au

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ABBREVIATIONS

Term	Definition
AACE	Association for the Advancement of Cost Engineering
AEMC	Australian Energy market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
augex	Augmentation capital expenditure
BESS	Battery Energy Storage Systems
Capex	Capital expenditure
CAPEX	Capital Expenditure
CBA	Cost Benefit Analysis
CPA	Contingent Project Application
CPI	Consumer Price Index
ECI	Early Contractor Involvement
EIS	Environmental Impact Statement
EMCa	Energy Market Consulting associates
ENA	Electricity Networks Association
ESB	Energy Security Board
EUAA	Energy Users Association of Australia
FID	Final Investment Decision
ISP	Integrated System Plan
NER	National Electricity Rules
NPC	Net Present Cost
NPV	Net Present Value
NSW	New South Wales
opex	Operating expenditure
PACR	Project Assessment Conclusion Report
PADR	Project Assessment Draft Report
PEC	Project Energy Connect
PSCR	Project Specification Consultation Report
RCP	Regulatory Control Period
RIT-T	Regulatory Investment Test
SME	Subject Matter Experts
SP	Separable Package

Term	Definition
TCD	Transmission Cost Database
TNSP	Transmission Network Service Provider

EXECUTIVE SUMMARY

Transgrid's Stage 1 CPA

1. HumeLink is a project that will result in a 500kV transmission line of around 360km, together with associated substations and related equipment, and which will link the greater Sydney areas to Snowy generation.
2. Transgrid has applied to AER for a contingent project capex allowance of \$321.87m¹ to cover the cost of 'early works' that are presented as 'Stage 1' of the 'HumeLink' project. Transgrid's plan is to complete Stage 1 early works by June 2024.
3. AEMO has published its 2022 Integrated System Plan (ISP), in which it denotes HumeLink as a staged actionable project, based on cost and timing information that Transgrid provided to AEMO. The AEMO ISP assessment is that HumeLink is likely to provide net economic benefits to the market and, in the final version of the 2022 ISP, AEMO has denoted the project as 'urgent' and seeks commissioning by July 2026.

Scope of our assessment

4. We have sought to address three key questions:
 - To what extent are Transgrid's Stage 1 objectives appropriate and aligned with the need that AEMO has identified?
 - Does the set of activities that Transgrid proposes represent a prudent plan to meet the defined scope?
 - Does the proposed capex allowance represent an efficient level of expenditure for the proposed activities in Transgrid's plan?
5. We have not been asked to review the economics of the HumeLink project, though we have considered the relevance of factors influencing the project economics and timing requirements to the objectives and scope of the Stage 1 project.

Our assessment of Transgrid's Stage 1 objectives

Transgrid has defined objectives as determining prudent and efficient costs, managing project risk and meeting a target delivery date

6. In its CPA, Transgrid has defined its intended outcomes from Stage 1 as determining prudent and efficient construction costs (for Stage 2), identifying, exploring and managing project risks and achieving AEMO's target delivery date of 2026-27. We asked Transgrid to define its objectives for the project, and Transgrid reiterated these outcomes as its objectives.
7. Transgrid did not initially identify 'improving cost certainty' as an explicit objective, though this objective can be reasonably inferred from responses Transgrid provided to our information requests.
8. We consider that the Stage 1 project has been designed around a primary objective of being able to deliver the commissioned HumeLink project (i.e. Stage 2) as soon as practicable.

¹ Transgrid has presented its proposed expenditure allowance in \$2018 and we refer to costs in this report in these terms, unless otherwise stated. In its CPA, Transgrid proposes that it will commence recovering revenue for this expenditure from 2024/25 and, for revenue allowance purposes, it has escalated the capex for this project using CPI indices along with the proposed capex from its Revenue Proposal, in its amended PTRM. Consistent with its Revenue Proposal, we understand that Transgrid has not applied real cost escalation to its capex forecast.

Significant components of the Stage 1 scope, which we assess to be around 50% of the Stage 1 cost, are primarily designed to meet this objective.

Transgrid has not defined optionality or option value as an objective

9. Transgrid summarises AEMO's 2022 ISP's identification of the benefits of Stage 1 as providing option value, insurance value and continual improvement value.
10. AEMO's insurance value objective effectively maps to Transgrid's objective for timely delivery, while AEMO's continual improvement objective can be considered equivalent to Transgrid's objective of seeking a prudent and efficient cost. However, Transgrid did not explicitly identify optionality for future (Stage 2) decisions, or option value from Stage 1, as intended outcomes or objectives.

Our assessment of Transgrid's Stage 1 scope and plan

Transgrid's plan represents a reasonable approach to achieving delivery in the shortest feasible time

11. Transgrid's Stage 1 plan comprises detailed design, technical investigations, contractor selection, long lead-time equipment bookings, environmental approvals, community engagement and acquisition of land and land options. To a significant extent, these activities occur in parallel.
12. We consider that Transgrid's planned Stage 2 commissioning date of December 2026 is ambitious, and AEMO's July 2026 target even more so. Nevertheless, we consider that Transgrid's Stage 1 plan captures the necessary activities and represents a reasonable approach in seeking to achieve commissioning as early as practicable.

Transgrid's plan represents a reasonable approach to containing cost and improving cost certainty

13. We consider that Transgrid has designed the scope of Stage 1 appropriately to enable it to reduce cost uncertainty and reduce risk for Stage 2 construction, for example through detailed design and competitive procurement activities. In response to requests from stakeholders, AER and ourselves, Transgrid has provided cost uncertainty targets for Stage 2 approval that we consider to be reasonable.
14. We consider that Transgrid's plan also provides a reasonable opportunity to identify ways to contain the eventual Stage 2 cost. For example, we consider that the approach that Transgrid is taking, in particular with its Early Contractor Involvement (ECI) process will provide Transgrid with a cost-effective means of achieving a detailed design with mitigation and management plans for identified risks.
15. We observe that Transgrid's costing for the full HumeLink project is a Class 4 preliminary estimate with a range of +50% / -30%. We understand that it does not include allowance for real cost escalation. Transgrid has provided information on significant real cost increases that have already occurred and that are likely to impact the HumeLink project. This reinforces the importance of improving cost certainty and taking all reasonable and responsible steps to contain the overall cost, if HumeLink is to eventually provide a net market benefit.

Transgrid's plan does not define how Stage 1 information will maximise option value as input to the later consideration of alternative Stage 2 decisions

16. In its Final 2022 ISP, AEMO states that '*a staged delivery provides protection against rising project costs*' and that '*(a) material increase in project costs will test the timing of the project*

and the rationale of the ODP². AEMO also states that *'(p)roject implementation (Stage 2) remains subject to the ISP feedback loop, which will assess whether the project remains aligned with the latest ISP prior to the final investment decision.'*

17. Transgrid's Stage 1 plan effectively provides for a 'single path' transition from Stage 1 early works into Stage 2 construction with accelerated delivery then through to commissioning. The plan largely precludes meaningful 'optionality' on completion of Stage 1, by assuming that AEMO's feedback loop and AER's Stage 2 determination take place before Stage 1 is complete and before a new ISP is available. The plan does not consider outcomes from the AEMO feedback loop, AER determination processes and Final Investment Decision (FID) other than in each case to assume that it provides endorsement to proceed immediately into Stage 2 at the (then-estimated) total HumeLink cost.
18. Accordingly, the plan shows no recognition of Stage 1 providing information that provides option value for consideration of alternative paths with regard to Stage 2, the potential for which is the underlying premise for project staging and optionality such as is referred to in the AEMO 2022 ISP. Nor, therefore, does the plan consider the implications of alternative Stage 2 paths such as AEMO refers to in its ISP, for example in terms of the impact of such paths on overall HumeLink project cost, project risk, potential regret or dependencies from or for other projects, notably Snowy 2 commissioning. The plan consequently does not explicitly reference how it will contribute to consideration of such alternative paths, the points at which options could realistically be exercised, or the information value that Stage 1 will provide in time to inform option decisions.

Timing within Transgrid's plan further limits Stage 1 option value

19. Transgrid's plan has its submission for the AEMO feedback loop for Stage 2 occurring in October 2023, 9 months before Stage 1 is to be complete. While Transgrid's cost information at that time will be better than its current preliminary estimate, Transgrid will still be part way through significant steps including environmental and community and stakeholder engagement processes and contractor engagement, which could have a significant bearing on HumeLink's eventual cost, risk and achievable timing. Market benefit information, while always imperfect, will similarly be less mature.
20. If accelerated delivery is accepted as the primary objective, then it may be inevitable that this is at the expense of optionality. If this is less clear cut, and HumeLink Stage 1 is considered as offering an opportunity to provide market economic benefits, but is not a system technical necessity, then the limited optionality offered under Transgrid's Stage 1 plan could be considered to increase the risk of 'regret'.

Our assessment of the efficiency of Transgrid's proposed Stage 1 expenditure

Transgrid's Stage 1 cost is a reasonable estimate, for the given scope

21. Transgrid has primarily built up its Stage 1 cost estimate through a bottom-up cost estimating process. Transgrid has provided supporting evidence, including through quotes, competitively sourced contract costs, benchmarks to other recent large transmission cost components and external advice. Transgrid also engaged an external party to review its complete costing, and the consequent assurance report provides further supporting information and concludes that the cost is reasonable.
22. We consider that the costing methodology that Transgrid has applied is reasonable and, taken in conjunction with the benchmarks and external assurance information it has provided, we consider that its proposed cost is a reasonable estimate of its required Stage 1 capex.

² AEMO Final ISP, page 68. ODP is the Optimised Development Plan. In the 2022 ISP this plan includes HumeLink but with timing dependent on the 'market scenario'.

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1 INTRODUCTION

1.1 Purpose and scope

1.1.1 Purpose of this report

23. The purpose of this report is to provide the AER with advice to assist it with assessing Transgrid's Contingent Project Application (CPA) for Stage 1 of the proposed HumeLink project. The assessment contained in this report is intended to assist the AER in its own analysis of the capex allowance as an input to a determination on Transgrid's proposal to provide for the costs of this stage of the project to be recovered by inclusion in its revenue requirement.

1.1.2 Scope of requested work

AER's perspective on the assessment perspective for 'stage 1'

24. In clarifying the nature of the advice that it is seeking, AER advised that an important question is whether the scope of works proposed by Transgrid is appropriate for the staged CPA. AER advised that it was seeking advice on the value of undertaking the scope of the proposed Stage 1 early works, noting that Transgrid was proposing that these works would identify prudent and efficient (whole) project costs and that the Stage 1 early works would identify and minimise risks for the Stage 2 construction phase.
25. In other words, the assessment would not be considered to meet National Electricity Rules (NER) objectives by considering Stage 1 solely in terms of being a 'pre-construction' phase preceding a 'construction' phase of the eventual full HumeLink project. From a regulatory perspective, the Stage 1 project is intended to benefit energy consumers by ensuring they don't pay more than necessary for the full project, while also providing option value to ensure the project only proceeds if remains the preferred option.
26. The AER advised that it had previously agreed that there is value in providing Transgrid with revenue recovery of future activities (through a separate contingent project application), prior to committing to the full project and that this is the purpose of a staged contingent project.

Defined scope

27. AER defined the scope of work that it was seeking from EMCa, as shown in Figure 1.1.

Figure 1.1: Scope of work as defined by AER

Defined scope of work

1. *Evaluating the scope of activities proposed by Transgrid for 'early works'. This is to ensure that Transgrid are proposing to do the right things (e.g. activities to better improve project cost estimates and manage risk), and are not bringing forward costs unnecessarily, or seeking revenue recovery of activities that may lock Transgrid into a specific scope of works for the full project.*
2. *Assessing the efficiency of the costs of the components of the application (with a focus on high priority areas).*

Source: Email communication between EMCa and AER, 7th April 2022

28. At an early stage in our engagement, with AER, we met with AEMO and this provided additional information on the perceived objectives of Stage 1 in designating HumeLink as a staged actionable project in the AEMO Draft ISP. By agreement with AER, the scope of our review was refined to define the focus as being on:
- Assessment of the appropriateness of Transgrid's defined objectives and, in particular, by reference to the AEMO ISP;
 - Assessment of the scope and prudence of the activities that Transgrid has included in that its Stage 1 approach and plan, and
 - Assessment of the efficiency of the costs of the capex components in Transgrid's Stage 1 CPA.

Scope limitations

29. To the extent that Transgrid's proposed justification for this project is based on electricity market modelling, we have reviewed the process and methodologies applied, as described in documentation and models that Transgrid has provided as well as AEMO documentation that Transgrid refers to. Our review does not encompass independent market modelling. While we have sought to identify the source of assumptions made by Transgrid and its consultants, our review should not be construed as an independent critique of all assumptions inherent in the modelling provided.
30. The limited nature of our review does not extend to advising on all options and alternatives that may be reasonably considered by Transgrid, nor should our technical report be construed as providing definitive advice on the proposed CPA project's compliance with the NER objectives and criteria or other aspects of the NER. Our advice is intended to assist AER with its own assessment and eventual determination under the NER.

1.2 Our approach

1.2.1 Approach overview

31. In undertaking our review, we:
- completed a desktop review of the information provided to us by the AER;
 - prepared requests for information to Transgrid, and reviewed the information provided by Transgrid (via the AER); and
 - undertook virtual review meetings with Transgrid, to ensure we correctly understood elements of the project as proposed, and the additional information provided.
32. We also had a virtual meeting with AEMO, to better understand the analysis that AEMO had done in arriving at the view that HumeLink should be a staged actionable ISP project, and to better understand AEMO's perspective on the objectives and benefits of staging the project with Stage 1 to complete early works by mid-2024. AEMO also provided further background to confirm references to the target delivery date and with regard to the scenarios, options and optimal development paths and their implications in particular for Stage 1 early works.

1.2.2 Sources of information

33. Our principle source of information for review is the suite of documents and models that Transgrid provided in support of its CPA. These are reproduced in Appendix A. We also took account of Transgrid's Project Assessment Conclusion Report (PACR), which Transgrid published in July 2021, and an addendum to this report that Transgrid published in December 2021.
34. For context on the project and, in particular, the Stage 1 early works objectives in the context of perceived economic benefits, we referred to the AEMO 2022 ISP and associated

- documents and models. This was available in draft form from the beginning of our project and we necessarily relied on this.
35. AEMO published the final 2022 ISP on 30th June 2022. We reviewed the final version to identify changes relative to the draft that we had relied on for our assessment.
36. The majority of our assessment was conducted by 30th June 2022 and for that period the AEMO 2022 ISP had been published only as a draft. AEMO published its final 2022 ISP on 30th June 2022 and we have referred to this in considering any implications for our assessment. Whilst we observe changes to wording in relation to HumeLink, and updated analysis, our view is that the final 2022 ISP does not change the substance of findings that we had already drawn based on access to the Draft.
37. We submitted further and final information requests to Transgrid, through AER, in early July and Transgrid replied to these on 13th July. By agreement with the AER, we agreed to consider materials provided to us up to this date and our report has been finalised on this basis.
38. Further information on the information that we reviewed is provided in Appendix A.

1.3 This report

1.3.1 Structure of this report

39. The following sections of our report include the following:
- In section 2, we provide an overview of the overall economics of the HumeLink project and the implications for consideration of the proposed Stage 1 ‘early works’;
 - In section 3 we describe the key elements of Transgrid’s CPA, including relevant factors from the AEMO ISP which defines the project as ‘actionable’;
 - In section 4 we provide our assessment of the CPA. This is structured into three parts which in turn address our review of:
 - The appropriateness of the objectives that Transgrid has defined for the Stage 1 project, including by reference to the intended benefits described by AEMO;
 - The scope of activities that Transgrid proposes to undertake in Stage 1; and
 - The Stage 1 costing in which Transgrid has based its proposed capex allowance for these activities.
40. In appendices we provide the following:
- In Appendix A, we document key information sources that informed our review.
 - In Appendix B, we provide background contextual information that we took into consideration. This includes information on the current regulatory framework for transmission including the RIT-T and CPA processes and some information on the wider program of transmission investments that Transgrid envisages developing over similar timeframes to the HumeLink project.
 - In Appendix C, we provide a summary of the Stage 1 project scope and with a mapping of the elements of the project against the Stage 1 project objectives.

1.3.2 Presentation of expenditure amounts

41. Transgrid’s CPA presents the project costs in \$2017/18 terms. To assist with cross-checking, we have maintained expenditure references in \$2017/18 terms unless we state otherwise.

2 IMPLICATIONS OF ASSESSMENTS OF THE HUMELINK PROJECT OVERALL, FOR ASSESSMENT OF THE STAGE 1 CPA

2.1 Introduction

2.1.1 The role of the Stage 1 ‘project’ in the context of building HumeLink

42. AEMO has designated HumeLink as a staged actionable project in its ISP, on the basis of AEMO’s assessment that it expects HumeLink to provide a net market benefit, and for that benefit to be optimised if it is built as early as possible.³
43. Transgrid has supported its CPA for Stage 1 with modelling indicating its assessment of the overall benefits of the full HumeLink project, of which the proposed CPA covers Stage 1 of the two-stage process that would culminate with HumeLink commissioned and operational.
44. It follows that Stage 1 does not provide any market benefit in itself but, as proposed by Transgrid, represents a pre-construction step enabling the subsequent building of HumeLink as Stage 2, assuming it is confirmed at the next AEMO feedback loop assessment. Transgrid summarises AEMO’s characterisation of Stage 1 accordingly as providing the following benefits:
- Option value;
 - Insurance value; and
 - Continual improvement value.
45. In respect of each of these Stage 1 benefits, therefore, the potential value from Stage 1 derives from the assumed eventual value of HumeLink itself. An understanding of the factors influencing the economics of the overall HumeLink project assists in order to be able to evaluate the relative importance of the different Stage 1 objectives, and which then drive Stage 1 scope requirements.

2.1.2 Source of HumeLink project analysis

46. In this section, we draw on various analyses undertaken for Transgrid and by and for AEMO. This includes the models from which the parties have sought to determine the net economic benefits of HumeLink, and its optimal timing.
47. EMCa has not independently reviewed these models or assessed the assumptions and parameters inherent in them, other than to the extent of seeking to understand how they operate. Accordingly, results presented here are based on these models and we leave it to readers to form their own views on the validity of those models and consequent outputs.

2.2 Summary of relevant HumeLink economic analyses

2.2.1 HumeLink project economics and its relevance to cost containment and cost uncertainty reduction objectives in Stage 1

48. In its CPA, Transgrid refers to HumeLink as providing \$491m NPV in net benefits. Transgrid’s consultants determined this figure in their PACR addendum RIT-T modelling, as

³ AEMO defines this as being by ‘2026-27’, but further refines this to ‘July 2026’. See AEMO 2022 Final ISP, pages 68 and 67

a weighted average that derives from results for the four market scenarios considered at that time. We reproduce the results of this analysis in Table 2.1.

Table 2.1: HumeLink NPV (as presented by Transgrid in its RIT-T PACR)

Market scenario	NPV (\$2021 million)
Central case	520
Step change	1,271
Slow	-1,177
Fast	487
Weighted	491

Source: EMCa table derived from information in Transgrid Houston Kemp spreadsheet: Humelink-pacr-addendum-npv-model-results.xls

49. As a sensitivity test, we tested Transgrid's same RIT-T model with the upper end of its capex uncertainty range (+50%). The results are shown in Table 2.2.

Table 2.2: HumeLink NPV, using Transgrid's RIT-T model but with Capex +50%

Market scenario	NPV (\$2021 million)
Central case	-727
Step change	24
Slow	-2,423
Fast	-760
Weighted	-756

Source: Transgrid Houston Kemp spreadsheet: Humelink-pacr-addendum-npv-model-results.xls, with EMCa applied capex sensitivity

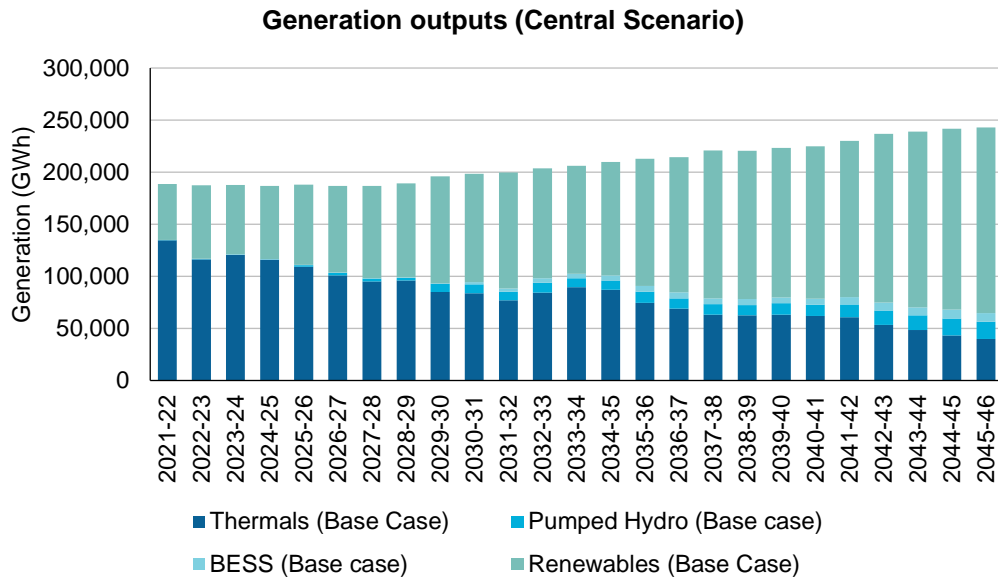
50. While this result represents the extreme upper end of Transgrid's current uncertainty range, the impact of HumeLink cost uncertainty on its NPV is nevertheless significant. This reinforces the Stage 1 objective of continual improvement seeking to contain the eventual project cost and the need in this stage to reduce cost uncertainty, so as to provide sufficient confidence in the project economics prior to Stage 2.

2.2.2 HumeLink market impact and its relevance to delivery-related scope objectives in Stage 1

Market generation forecasts

51. The market impact of HumeLink has more recently been analysed by AEMO in its Final 2022 ISP. However, at the time of its Stage 1 CPA, Transgrid's supporting analysis was contained in modelling conducted for its PACR by its consultant EY. This modelling shows the market impact that is the source of the benefits that HumeLink will provide.
52. Figure 2.1 provides the base modelled generation output. We have grouped together here all thermal sources, all renewables primary generation, separating out pumped storage and Battery Energy Storage Systems (BESS). The modelling (for this market scenario) shows increased renewables generation and a steady decline in thermal generation, with a small but increasing role for storage (from pumped hydro and BESS).

Figure 2.1: Modelled generation output (as modelled by EY for Transgrid PACR)

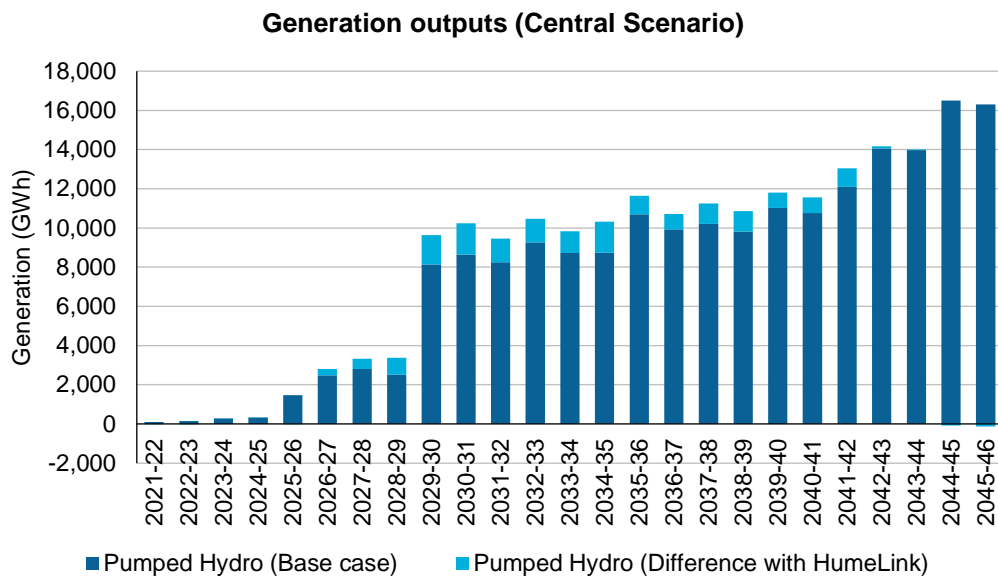


Source: EMCa chart, derived from EY PACR market modelling outputs for the Central market scenario

Impact for pumped hydro

- 53. Figure 2.2 shows the modelled output from pumped hydro, primarily initially being from Snowy 2. The dark blue columns show the level of output from the ‘base case’, which is a counterfactual in which HumeLink is not built, while the light blue increments indicate the additional pumped hydro output that is expected to be achieved from additional capacity provided by HumeLink.
- 54. The linkage between HumeLink and Snowy 2 commissioning is evident from the graph. We observe that the modelling indicates significant output from Snowy 2 in the counterfactual and shows that HumeLink would provide for incremental pumped hydro output up to around 2041-42.

Figure 2.2: Generation output showing the impact of HumeLink for pumped hydro

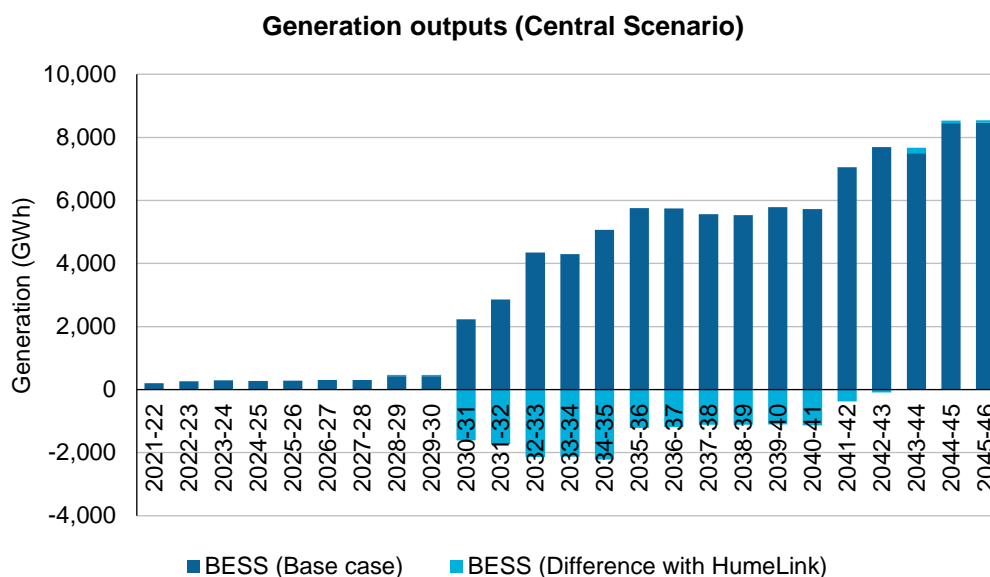


Source: EMCa chart, derived from EY PACR market modelling outputs for the Central market scenario

Impact for BESS

55. In Figure 2.3, we show the impact of HumeLink for assumed BESS, showing that according to the EY model produced for Transgrid, HumeLink (and the resulting additional output from Snowy 2) is assumed to result in less BESS required.

Figure 2.3: Generation output showing the impact of HumeLink for BESS



Source: EMCa chart, derived from EY PACR market modelling outputs for the Central market scenario

Other generation impacts

56. From the PACR modelling that Transgrid provided, HumeLink will have a minimal impact on the quantum of generation from renewables (in aggregate) and also a minimal impact on aggregate thermal generation over the modelled period.

Implications for Stage 1

57. Based on Transgrid’s analysis, the HumeLink benefit is primarily attributable to the assumed ability to obtain increased output from Snowy 2. This suggests that the optimal timing of HumeLink commissioning is closely linked to the timing of Snowy 2. This in turn would appear to have implications for the design of Stage 1, to the extent that it is designed around facilitating construction in Stage 2 to meet a particular commissioning target, as compared with other non timing-related objectives.

2.2.3 AEMO’s 2022 ISP assessment and its relevance to the Stage 1 delivery objectives

HumeLink timing considerations in the AEMO Final 2022 ISP

58. AEMO has designated HumeLink as an ‘Actionable Project’ ‘to be progressed urgently’ with a ‘latest delivery date’ of July 2026.⁴
59. In its assessment of the optimal timing of each major network project, AEMO presents the table shown here as Figure 2.4, showing the optimal timing of HumeLink under each of the market scenarios that AEMO defined. This shows optimal HumeLink timings from 2027-28 to 2037-38. AEMO then explored the ‘...option value of staging projects so that they may be paused at an appropriate future checkpoint prior to final investment decision.’⁵ Further

⁴ AEMO 2022 Final ISP, Table 1

⁵ AEMO 2022 Final ISP, page 81

considerations of option value and insurance value led AEMO to the conclusion that HumeLink should be actionable as a staged project, with the delivery date of July 2026 as referred to above.

Figure 2.4: Optimal timing of major network projects in each scenario, assuming perfect foresight

Project	Earliest Commissioning Date	Slow Change	Progressive Change	Step Change	Hydrogen Superpower
Sydney Ring	2027-28	2039-40	2027-28	2027-28	2027-28
New England REZ Transmission Link	2027-28	2027-28	2027-28	2027-28	2027-28
HumeLink	2026-27	2037-38	2035-36	2028-29	2027-28
Marinus Link (Cable 1)	2029-30	2034-35	2030-31	2029-30	2029-30
Marinus Link (Cable 2)	2031-32	2037-38	2032-33	2031-32	2031-32
VNI West	2030-31	2040-41	2038-39	2031-32	2030-31
Gladstone Grid Reinforcement	2027-28	Not needed	2035-36	2030-31	2028-29
CQ – SQ Stage 1	2025-26	2040-41	2030-31	2028-29	2028-29
QNI Connect	2028-29	2035-36	2036-37	2032-33	2029-30
New England REZ Extension	2031-32	2045-46	2038-39	2035-36	2031-32

Note: Green shading shows those projects that would be optimally delivered in line with the earliest commissioning date, or one year delayed. Pink shading shows those projects that would likely be re-assessed as actionable at the 2024 ISP, being within 2-3 years of the earliest commissioning date and assuming no risk of schedule slippage. AEMO is continuing to work with project proponents to re-assess the earliest commissioning timings and any options available to expedite individual projects.

Source: AEMO Final 2022 ISP, Table 8

HumeLink requirement for system security and economic benefit

60. Our reading of the ISP is that it seeks to identify the optimal development path from a net economic benefit viewpoint, and that all such development paths must maintain system security. The evaluations in the ISP are presented in this way, with market net benefits presented as the primary metrics in comparing candidate development paths and project options and variants.
61. If HumeLink timing affects only the market benefit economics, then the indications from the AEMO Final 2022 ISP analysis are that there is a relatively shallow ‘optimum’ timing and that there is minimal (and perhaps no) loss of market economic benefit if HumeLink is deferred relative to July 2026. However, the Final 2022 ISP also refers to the value of HumeLink in mitigating the risk of a dispatchable capacity shortfall and it appears that this is the driver for AEMO’s nomination of the July 2026 target delivery date, its designation of this timing as ‘urgent’ and AEMO’s identification of HumeLink providing an ‘insurance value’.

Implications for Stage 1

62. Of relevance to Transgrid’s scope for Stage 1, therefore, is that AEMO’s ISP direction can be taken as requiring Transgrid to progress Stage 1 on the basis that it facilitates HumeLink being commissioned ‘as soon as possible’. By designating HumeLink as actionable only on a staged basis, however, AEMO’s plan leaves open the option that the project could be paused, following Stage 1, if the best available information at that time indicates that this is the prudent action.
63. The relative balance between Stage 1 objectives such as Stage 2 delivery, optionality, insurance value, cost containment and risk management, and the consequences of the balance of these objectives for Transgrid’s stage 1 scope and plan, depend on interpretation of AEMO’s ISP assessments. Of particular importance is the extent to which the key HumeLink drivers are economics-based or system security based, and the extent to which the ‘alternative Stage 2 timings’ that are analysed and presented in the ISP, are relevant to the objectives and scope of Stage 1. We refer to these themes in section 4.

3 TRANSGRID’S CPA FOR HUMELINK STAGE 1

3.1 Transgrid’s proposal for Stage 1 ‘early works’

64. Transgrid has applied for a contingent project capex allowance of \$321.87m⁶ to cover the cost of ‘early works’ that are presented as ‘Stage 1’ of the ‘HumeLink’ project. HumeLink is a project that will result in a 500kV transmission line of around 360km, together with associated substations and related equipment, and which will link the greater Sydney areas to Snowy generation.
65. Transgrid’s proposed early works are as summarised in Table 3.1.

Table 3.1: Category and description of Transgrid’s proposed Stage 1 works

Category	Description
Direct capex	
Procurement	Steel tower assembly design and prototype testing
	Long-lead time equipment (LLE) – Substation transformers and reactors
	Pre- construction development – substation and transmission lines
Land acquisitions	Valuation and acquisition costs including options to acquire easements and acquiring a site for Gugaa substation, and cultural heritage
Labour and indirect capex	
Project team resources	Labour and corporate support for project management, procurement, land and environmental activities
Project development	Development, engineering, legal and economic support
Land and environment	Fees, labour and indirect costs
Procurement	Bidder payments
	Data room services and market road show
	Transaction procurement support
Community & stakeholder engagement	Stakeholder and community programs including social legacy, design and communication and community improvement
Regulatory approvals and other support costs	RIT-T and CPA activities including document preparation, modelling and commissioning expert reports

Source: Summarised from Transgrid CPA, Table 7

66. The capex for which Transgrid is seeking an allowance was incurred starting from 2017/18 and Transgrid has defined Stage 1 early works as being completed by end June 2024. For more information on the cost of each category of expenditure, please refer to section 4.4.

⁶ Transgrid has presented its proposed expenditure allowance in \$2018 and we refer to costs in this report in these terms, unless otherwise stated. In its CPA, Transgrid proposes that it will commence recovering revenue for this expenditure from 2024/25 and, for revenue allowance purposes, it has escalated the capex for this project using CPI indices along with the proposed capex from its Revenue Proposal, in its amended PTRM. Consistent with its Revenue Proposal, we understand that Transgrid has not applied real cost escalation to its capex forecast.

3.2 HumeLink as a ‘staged actionable project’ in AEMO’s 2022 ISP

67. AEMO published its final 2022 ISP on 30th June 2022. HumeLink is one of five transmission projects that are described as ‘actionable’ in the ISP, with an actionable delivery date of July 2026. AEMO refers to HumeLink as a ‘*staged actionable ISP project*’ with Stage 1 early works to be completed by ‘*approximately 2024*’.
68. With regard to AER’s consideration of the CPA, the ‘identified need’ is based on AEMO having identified HumeLink as a staged actionable project in its 2022 ISP. However, except to the extent that a ‘need’ has been defined by AEMO, AER’s determination on the CPA is required to consider the extent to which the proposal meets the capex objectives and the capex criteria. That is, within the context of AEMO’s identification of the need for HumeLink, it is for AER to determine if the proposed expenditure is prudent and efficient.

4 OUR ASSESSMENT OF TRANSGRID'S STAGE 1 CPA

4.1 Introduction

69. We have structured our assessment to answer three key questions:
- To what extent are Transgrid's Stage 1 objectives appropriate and aligned with the need that AEMO has identified?
 - Does the set of activities that Transgrid has proposed represent a prudent plan to meet the defined scope?
 - Does the proposed capex allowance represent an efficient level of expenditure for the proposed activities in Transgrid's plan?
70. From this, we provide our advice on the reasonableness of Transgrid's CPA.

4.2 To what extent are Transgrid's Stage 1 objectives appropriate and aligned with the need that AEMO has identified?

4.2.1 What objectives has AEMO defined for HumeLink Stage 1?

71. In its 2022 ISP, AEMO has defined the need for HumeLink as arising from delivery of a 'market benefit' through increasing transfer capacity and stability limits for power from Snowy region, enabling access to lower cost generation and facilitating development of renewable generation in southern NSW. In discussion with AEMO during our review, the need was confirmed as being 'economic' in that the counterfactual would involve an alternative 'development path' that would meet the needs of consumers, albeit AEMO assessed that the counterfactual would meet those needs at a higher cost.
72. From AEMO's draft ISP, Transgrid has essentially summarised the AEMO Draft ISP direction to proceed to Stage 1 as being based on providing delivery assurance (i.e. for the commissioned project on completion of 'Stage 2'), while also providing option value, reducing cost uncertainty and seeking improved cost accuracy, with prudent and efficient costs.⁷
73. In its Final 2022 ISP, AEMO's description of the value of HumeLink appears to go beyond the net economic benefit rationale that underpins its assessment of the Optimal Development Path, and which suggests a security-related concern. AEMO describes this as follows:⁸

The value of the project is in mitigating the risk that not enough dispatchable capacity is available if there are early coal closures in the period 2026 to 2028. That risk may be realised if a third New South Wales coal-fired power station (including Liddell) retires, and two of those four closures have already been announced as likely to occur by 2025.

⁷ This is a precis of AEMO positions as summarised by Transgrid on page 2 of its CPA, and which it references from page 80 of the Draft 2022 ISP

⁸ AEMO Final 2022 ISP, page 68

4.2.2 What objectives has Transgrid defined?

74. In its CPA, Transgrid describes the outcomes that Stage 1 will deliver.⁹ Through reference to the AEMO draft ISP, Transgrid describes the intended benefits of Stage 1 as providing option value, insurance value and continual improvement value.
75. We asked Transgrid to define its objectives for Stage 1. Transgrid's response is from the outcomes referred to in its CPA, as above. We repeat the main parts of this as follows:¹⁰

'...our objectives for our Stage 1 (Early Works) are to:

- Determine the prudent and efficient construction cost for Stage 2 (project implementation) by refining the Project scope through innovation and cost effective design*
- Identify, explore and manage the project risks. This will allow us to mitigate and/or diversify the Project's risks so that the residual risk costs included in our Stage 2 Application (which will include the bulk of the Project's costs) are as low as possible, and*
- Progress activities on the critical path and undertake engagement to retain our social licence in order to achieve AEMO's target delivery date of 2026-27 (i.e. 'as soon as practicable')*

4.2.3 Our assessment

Assessment of the Stage 1 scope first requires consideration of what are the objectives of Stage 1 and to what extent is the proposed scope based on those objectives

76. Because Stage 1 is not intended to deliver the physical commissioned HumeLink project, it is necessary to consider what it is intended to deliver, in order to be able to assess the extent to which the scope of the proposed work is consistent with meeting that objective. That in turn allows assessment of the prudence and efficiency of the proposed works.
77. Following its response describing its objectives, we asked Transgrid to identify the objectives that apply to each work component described in Table 7 of its CPA, and how each of those activities will contribute to delivering the stated objectives.
78. Transgrid provided its response by way of a table listing the work components from its CPA Table 7 and, for each component, describing the 'outcome' and 'objective' and providing additional comments.¹¹ We have assessed the overall scope of the work package that comprises Transgrid's Stage 1 proposal, by reference to its stated objectives.
79. By combining information in Transgrid's second response with its Stage 1 costing by 'category',¹² we have also been able to consider the extent to which the proposed cost is driven by the relevant objectives.

Except with regard to optionality, Transgrid's Stage 1 objectives largely align with the 'benefits' defined by AEMO

80. Transgrid's defined objectives of determining prudent and efficient costs and progressing activities on the critical path, are substantially consistent with the continual improvement and insurance benefits that AEMO identified as being required from Stage 1. For example, the insurance value that AEMO describes can be considered to be met by Transgrid seeking to be able to commission HumeLink as early as practicable, while the continual improvement value described by AEMO is equivalent to Transgrid's objective of seeking a prudent and

⁹ CPA, section 4.2

¹⁰ IR001. Transgrid response dated 13 May 2022.

¹¹ IR002. Transgrid response dated 25 May 2022. Table 1.

¹² Transgrid CPA1, Table 9

efficient Stage 2 cost. Transgrid's objective of identifying, exploring and managing risks can be seen to contribute to both of these AEMO-defined benefits.

81. The notable difference between AEMO's defined benefits and Transgrid's defined objectives relates to optionality. Transgrid does not refer to optionality or option value in defining its Stage 1 objectives. At best, this can only be inferred from the references to the AEMO feedback loop, AER Stage 2 determination and FID in its project plan. In section 4.3.2, we explore further the extent to which option value is evident in Transgrid's Stage 1 plan.

Transgrid's primary objective is delivery and this drives around 50% of the proposed cost

82. In its CPA, Transgrid refers strongly to the importance of project delivery. For example, in its introduction, it states that it will '*...progress activities on the critical path to deliver HumeLink by AEMO's 2026-27 target delivery date (i.e. "as soon as practicable").*'
83. Transgrid's IR002 response confirms the prominence that Transgrid has placed on critical path delivery of the project to this timeframe.¹³ Whilst Transgrid identifies some components of its proposed work as contributing to more than one objective, making a precise breakdown infeasible, our assessment is that approximately half of the works that Transgrid proposes are primarily aimed at seeking to assure 'on time' delivery. This includes works within Stage 1 such as:
- Land acquisitions and options;
 - Steel tower procurement and assembly for prototype testing;
 - Booking production slots for Long Lead-time Equipment (LLE); and
 - Pre-production development of substations and transmission lines, including detailed design and technical works.
84. A proportion of project team resources supports these delivery-focused components of work, and other components such as the inclusion of environmental assessments and community and stakeholder engagement in the 'Early Works' also contribute to Transgrid's delivery assurance objective.
85. In other words, Stage 1 early works that are designed only to provide option value, improved cost certainty and to contain costs, but without an overarching critical path delivery objective, would involve a scope and related cost that is around half of what Transgrid has proposed.

Transgrid did not define cost certainty outcome goals, implications or realisation plans

86. Transgrid does not directly describe an objective of improving cost certainty. Given the wide range of Transgrid's current preliminary cost estimate (-30% to +50%)¹⁴, and the evident sensitivity of net market benefits to this cost, we were surprised that this was not an explicitly defined objective. However, Transgrid's responses to subsequent enquiries that we made, and its responses to stakeholder feedback, clarified that Transgrid expects an improvement in cost certainty to arise from Stage 1, as we would expect.¹⁵
87. There is similarly no direct reference in Transgrid's CPA to the implications of cost uncertainty for a Stage 2 decision. Transgrid assessed capex sensitivities of +/-25% in its PACR, in the context of comparing what at that time were HumeLink options. Transgrid found the project to have a negative NPV at +25% capex, which is only half of the upper end of its current cost estimate uncertainty range.
88. In AEMO's Final 2022 ISP, while it refers to the desirability of improving cost certainty and reducing the overall cost of the project, there is similarly no reference in the main ISP document to the implications of the range of cost uncertainty currently present, on the

¹³ We observe some discrepancy on the assumed earliest possible delivery date: In its project plan (CPA Appendix A.3, Figure 6.1) Transgrid shows delivery in Q4 calendar 2026, with commissioning extending into early 2027. In discussions, Transgrid referred to a commissioning target of December 2026, and which is consistent with that plan. However, in its Final ISP (Table 6, page 67), AEMO has defined the assumed delivery date as July 2026.

¹⁴ From PACR Addendum report, December 2021

¹⁵ See for example Table 4.1 and associated source reference

overall economics of the project. However, it can be reasonably be inferred that a cost increase at the upper end of Transgrid’s current range (i.e. +50%) would render the project uneconomic, noting that this would represent an increase of approximately \$1.65bn.

89. In response to stakeholder feedback and to our information request, Transgrid provided information on the ‘class’ of cost estimates that it expects from Stage 1 and we refer to this in section 4.3.
90. Given the importance of limiting the overall project cost to the economic viability of the project, and Transgrid’s stated objective of doing so ‘...through innovation and cost-effective design..’, Transgrid might have considered developing a specific ‘cost reduction and innovation’ plan with measurable targets and an associated action plan. As we discuss in section 4.3, aspects of Transgrid’s approach (including the ECI process) are designed to contribute to this inferred objective. However, we consider that a specific workstream to meet defined project enhancement goals would more likely achieve such outcomes.

Explicit recognition of an ‘option value’ goal and optionality implications would have better aligned Transgrid’s Stage 1 project with the benefits that AEMO anticipates

91. We consider also that Transgrid CPA should have included an objective and an associated plan for providing information from Stage 1 to achieve AEMO’s optionality objective. This would have defined how the relevant elements of its work would provide option value by defining the information that is likely to be of material decision-making value and showing how that information will be made available to the parties with Stage 2 input and decision roles in time for that information to be taken into account.
92. We consider that an information value analysis and associated objective would clearly identify matters such as:
- The critical information of value to inform consideration of these options, and the target maturity level of such information at the optionality decision points, and
 - The contingent implications of alternative paths arising from the defined decision points, including with regard to potential regret costs, additional project costs, project risk implications and project critical path timing implications. For example, this would include stand-down or ‘hold-over’ costs associated with a potential pause, also rework costs and potential regret costs to the extent that any of these might apply under certain options pathways.
93. We consider that the Stage 1 project is likely to provide information that will contribute to an optionality objective. However, explicit recognition of this objective and an optionality information analysis would improve confidence that Transgrid’s plan will provide both the information to inform optionality and the flexibility to adopt alternative paths, should they be preferred to a direct and immediate transition to Stage 2.

4.2.4 Summary of findings on Transgrid’s proposed scope by reference to Stage 1 objectives

94. We consider that Transgrid’s objectives are essentially focused on ‘Stage 2 delivery’, with reference to ‘critical path’ activities and risk management, together with determining prudent and efficient costs. Transgrid’s CPA makes minimal reference to optionality or option value objectives, and which we understand is the primary basis for AEMO directing HumeLink as a staged project and directing action on only Stage 1 at this time.
95. We were initially concerned that Transgrid had not declared what specific, measurable outcomes it was targeting for improving cost certainty. Transgrid has since provided information on its expectations in this regard.
96. Transgrid has identified elements of its Stage 1 plan that it expects to contribute to its cost containment objective, but we do not observe any specific measurable goals or an action plan focused on this objective.
97. In summary, therefore, while Transgrid’s stated Stage 1 project objectives map to some of the intended outcomes that AEMO refers to in its 2022 ISP, it does not fully align. We

consider that clearly stated and aligned objectives, together with defined and measurable goals, are needed in order to be able to demonstrate what will be achieved from Stage 1 works and therefore to be able to justify the associated \$321.9m proposed capex allowance.

4.3 Does the set of activities that Transgrid proposes represent a prudent plan to meet the defined scope?

4.3.1 Overview of the scope of work that Transgrid has proposed

Transgrid's Stage 1 Early Works are primarily focused on delivering Stage 2 as early as possible

98. Transgrid's Stage 1 early works essentially comprise the works required to enable Stage 2 construction to follow promptly allowing HumeLink to be delivered as early as possible. In summary this comprises:
- Establishing a Transgrid project team of sufficient scale and skills mix to manage Stage 1 pre-construction activities and to plan and resource the program to enable it to progress directly to the construction stage (Stage 2);
 - Works design, commencing with pre-concept and concept designs and resolving in detailed design to a stage that allows for complete specification of equipment, materials and construction resources;
 - Selecting and appointing EPC contractors for the purpose of securing orders for the necessary equipment and finalising detailed designs, with those contractors having mobilised sufficiently to be able to commence construction immediately following on from Transgrid awards of work packages at the end of Stage 1;
 - Resolving the line route and substation locations, including the required land access through land purchases and purchase options and obtaining the necessary geotechnical information specific to siting requirements;
 - Resolving environmental requirements, including through completion of the Environmental Impact Statement and associated environmental approvals including environmental offset requirements; and
 - Undertaking community and stakeholder engagement and seeking sufficient 'social licence' such as through pro-active dialogue and through development of social legacy and community improvement programs.
99. Transgrid's Stage 1 CPA also includes its work associated with the necessary regulatory approvals, including the current CPA1 application to AER (including market and economic assessments), its input to AEMO's ISP, input to the AEMO 'feedback loop', its CPA to AER for Stage 2 and internal approvals leading to the Transgrid FID.

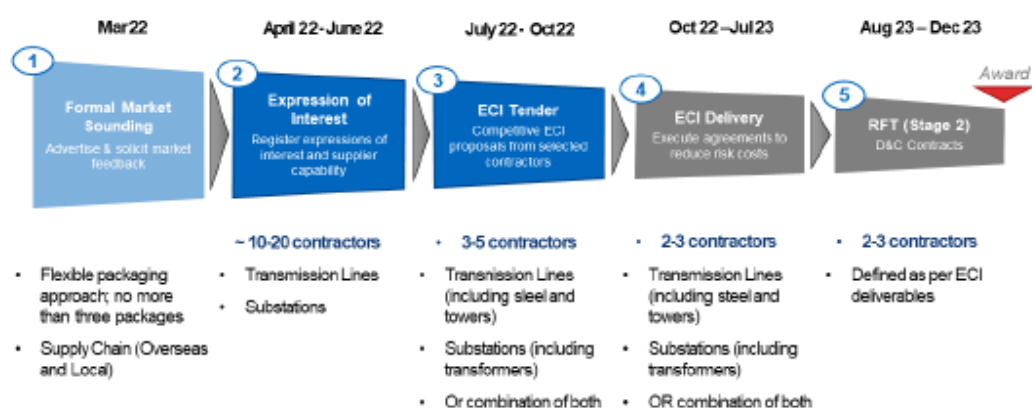
Through its Stage 1 Early Works, Transgrid also expects to be able to improve total project cost accuracy and reduce cost uncertainty and risk

100. Transgrid refers to its current cost estimate accuracy for the full HumeLink project (i.e. comprising Stage 1 early works plus Stage 2 construction) as 'Class 4'. This is represented as having an uncertainty range of -30% to +50%.¹⁶
101. Transgrid has presented almost all of the works described above as assisting it in determining prudent and efficient construction costs and identifying, exploring and managing Stage 2 project risks.
102. Transgrid makes particular mention of the role of its ECI procurement process in contributing to detailed design and improved cost accuracy. Under its ECI process,

¹⁶ Transgrid PACR addendum, Table 1

Transgrid is engaging with potential contractors under collaboration arrangements that involve payment of a fee (to losing bidders) for a range of defined design and pre-construction services that all bidders will provide. From the skills and experience of the contractors, and the competitive incentive that they have as potential bidders, Transgrid expects to be able to identify and incorporate enhancements into the Stage 2 project, reducing cost and risk from that which might otherwise have applied. Transgrid's summary of its ECI process is shown in Figure 4.1.

Figure 4.1: ECI and procurement timeline



Source: Transgrid CPA Appendix A.3, Figure 1

103. In response to our request for further information, Transgrid provided the following further explanation of the benefits of its ECI process:¹⁷

'An Early Contractor Involvement (ECI) procurement process is a form of highly interactive tender process which will help Transgrid better achieve value for money for energy consumers, through:

- *increased investigation and understanding of project risks and challenges during tender process, leading to better scope definition, optimized risk allocation and accurate pricing*
- *incorporating constructability and innovation into design, and then into pricing*
- *allowing for important activities to be undertaken before contract award, including design and environmental approvals, reducing the risk of variations and allowing the contractor to hit the ground running, and*
- *allowing us to "try before we buy" with multiple contractors, allowing contractor selection to include consideration of values alignment and working together criteria.*

Undertaking a collaborative ECI is consistent with best practice project delivery standards, which advocate for "front-end loading" projects with increased investigation and design works in the early stages of a project, to reduce risk, consequential variations and overall project costs & timeframes.'

4.3.2 Our assessment

Transgrid's Stage 1 scope represents a reasonable approach to achieving delivery in the shortest feasible time; however, the proposed timing is extremely ambitious

104. Transgrid's Stage 1 scope provides for pre-construction workstreams to be conducted in parallel, with the plan culminating in June 2024 with all such activities completed and thereby enabling construction to proceed without further delay (as Stage 2). We consider that Transgrid's Stage 1 plan captures the key necessary pre-construction activities and that

¹⁷ Transgrid response to AER IR#004, page 6

it represents an efficient approach to arriving at a construction commencement milestone. We observe no explicit timing contingency, and our opinion is that the Stage 1 plan is ambitious and essentially leaves no room for slippage.

105. The overall project plan that Transgrid has presented in its CPA (i.e. for Stages 1 and 2)¹⁸, shows HumeLink commissioning commencing towards the end of 2026 and ending in January 2027. We consider that this is ambitious for a project that is both of significant size, and which has significant impacts that are already being identified and challenged by stakeholder groups.
106. We sought further information on Transgrid's plan and in its IR#004 advice, Transgrid has marginally brought forward commissioning to December 2026. In its 2022 ISP, AEMO has nominated a target date of July 2026 for HumeLink to be commissioned by and Transgrid has advised that it is currently '*...actively reviewing [its] program with a view to identifying acceleration opportunities to ensure that [it] meets this date.*'¹⁹
107. We consider that a commissioning target of December 2026 will be challenging, and July 2026 clearly more so. We consider that Transgrid's Stage 1 plan does represent a reasonable approach to delivering HumeLink 'as soon as possible', whatever that timing may be. We would be concerned if further accelerating the project from Transgrid's current target was to lead to a risk of inadequate preparation, or activities being signed off ahead of thorough completion, potentially giving the appearance of an accelerated timeframe but at the expense of increased risk and higher eventual cost.

The maturity of cost, timing and risk information will be limited by Stage 1 activities that will be still unfinished when that information is required for the key Stage 2 decisions

108. From the project plan in its CPA,²⁰ Transgrid had assumed that it will submit its Stage 2 project for AEMO's 'feedback loop' in July 2023 and its Stage 2 CPA to AER in November 2023. In response to our information request, Transgrid amended these however to October 2023 and February 2024 respectively, as can be seen in Figure 4.2.²¹
109. These timings are 9 months and 5 months respectively before Transgrid's Stage 1 end date of June 2024. Moreover, Transgrid's plan shows some activities that it has described as contributing to determining the prudent and efficient cost, as occurring after the AEMO feedback loop and also after the assumed timing of AER's Stage 2 determination. This includes detailed design and booking of LLE.
110. Comparing Transgrid's project plan with its ECI process, it will have completed the ECI 'delivery' step and therefore will have the benefit of whichever design and specification enhancement arise from that process. However, at that stage, Transgrid will be part way through its environmental processes, also part way through its land acquisition processes and community and stakeholder engagement processes. It will be part way through its RFT processes and will not have received final bids from contractors. Transgrid also states that it '*...expect(s) to have completed the bulk of the detailed design by June 2024. The successful EPC contractors will undertake all detailed design work.*'²² This work, which we would expect to be a key input to a final costing, will therefore not have been completed at the time that Transgrid provides information to AEMO for the 'feedback loop'.

¹⁸ Transgrid CPA, A.3 Capex forecasting methodology, Figure 6.1

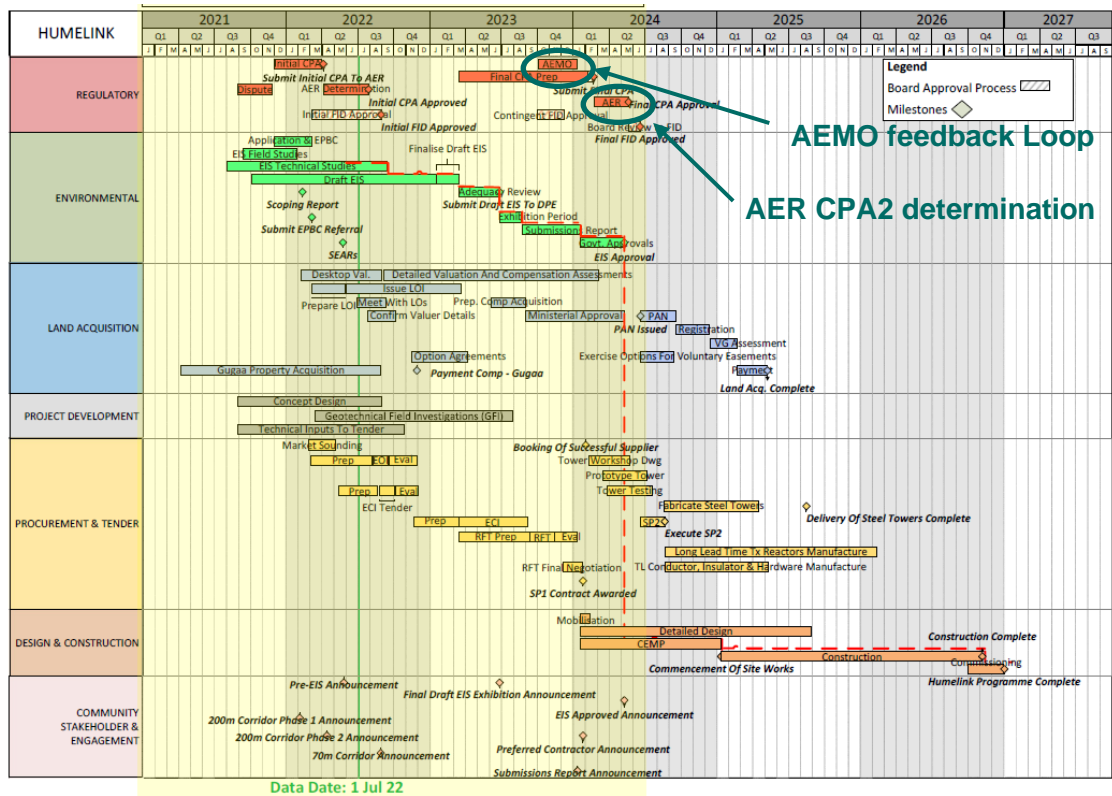
¹⁹ Transgrid response to IR #004, page 1

²⁰ CPA appendix A.3, Figure 6.1

²¹ Transgrid's response to IR#004. The relevant plan is reproduced at Figure 4.2 in the current report.

²² Transgrid IR#004 response, page 5

Figure 4.2: Transgrid’s project plan (updated as at 1 July 2022)



Source: Transgrid’s response to IR#004

111. Whilst the timing of the feedback loop 6 to 9 months before the completion of Stage 1 is understandable in the context of an accelerated delivery target, in our opinion this is at the expense of the maturity of information to be provided to AEMO for its assessment, and which will therefore contribute to a correspondingly greater margin of uncertainty.
112. We consider that the Stage 1 scope taken as a whole is likely to improve cost certainty and that, by the time of its intended submission to AEMO, Transgrid will have taken considerable steps towards to improving cost certainty. However, there is a fine balance between being able to provide AEMO with cost information that is fit for purpose for feedback loop assessment and jeopardising the project delivery timetable. The cost information provided to AEMO at the proposed timing will inevitably not reflect the benefits that will be realised from the remaining relatively substantial activities that are programmed to occur in the first six months of 2024. To the extent that the AEMO decision at that time is based on net economic benefits (consistent with the 2022 ISP assessment), as opposed to being a purely technical NEM security-based decision, this uncertainty increases the risk of an ‘actionable project’ direction from AEMO that later information may find to have been sub-optimal.
113. Transgrid’s plan assumes that it will submit to an AER CPA determination for Stage 2 in around February 2024. Cost certainty will by then be improved by a further 8 months’ progress with Stage 1 activities (relative to Transgrid’s submission for AEMO feedback loop), and therefore costs and risks relating to land, environmental requirements and stakeholder issues will then be considerably better known. Importantly, by this time, Transgrid will have provisionally accepted contractor tenders for Stage 2, providing a market basis for what is likely to be the majority of remaining costs. This information should provide a firmer basis than is currently available, for a regulatory approval of a capex allowance. However, by this time AER’s role will be limited to a determination on the capex allowance for the project, assuming that by then AEMO has confirmed the actionable status of the project.
114. Transgrid’s plan does not, therefore, allow for Stage 1 objectives of reducing cost uncertainty, reducing risk and containing costs, to be fully taken into account either by AEMO in its ‘feedback loop’ or by AER in determining a prudent and efficient allowance for

Stage 2. However, while these aspects of its Stage 1 works will not be complete, it appears that Transgrid will nevertheless have made substantial progress against these cost and risk objectives by this time.

Transgrid's scope and plan effectively provides for a 'single path' transition to Stage 2, with limited contribution to AEMO's optionality objective

115. The AEMO ISP describes project staging as providing optionality with respect to project timing and its need, based on an updated view on market scenarios and with updated information on costs and risks, following Stage 1. An option value requires that alternative options are feasible, at the time at which the option can be 'exercised'. In its modelling, AEMO has assumed that the timing of Stage 2 depends on the 'market scenario' and which is assumed to be known (or at least, better understood) on completion of Stage 1.²³
116. In addition to limitations in the maturity of cost, timing and risk information, at the time that Transgrid has assumed obtaining AEMO's feedback loop response, the maturity of AEMO's assessment of market scenarios and their implications will inevitably be on a transition path towards its 2024 ISP. The date that Transgrid plans to submit for the feedback loop is only (now) around 15 months from the date on which AEMO has published its Final 2022 ISP. AEMO will not have published a further ISP by October 2023. Transgrid's plan is therefore not entirely consistent with AEMO's modelling of an option value on completion of Stage 1 in June 2024, by which time AEMO will have published at least its Draft 2024 ISP.
117. While AEMO has promoted option value as a benefit of staging the project, and Transgrid has acknowledged this in introducing its Stage 1 scope, we consider that the Stage 1 scope and plan effectively provides for a 'single path' transition from Stage 1 early works into Stage 2 construction with accelerated delivery then through to commissioning.
118. Notwithstanding that AEMO's 'most likely' scenario currently requires Stage 2 to effectively follow directly from Stage 1, Transgrid's plan will provide a more limited contribution to optionality and greater cost certainty within the timeframe in which it can contribute to better-informed Stage 2 decisions. Further, because of the extent to which the Stage 1 cost is driven by its delivery objective, the 'regret cost' from any Stage 2 pathway that does not follow on from Stage 1, will be commensurately greater.
119. We observe that allowing for such optionality requires either a decision 'pause' on completion of Stage 1, or (as is assumed in Transgrid's Stage 1 plan) that the optionality decision is made before the end of Stage 1, with the information available at that time.
120. A decision pause would inevitably increase the cost of the project for a number of reasons, including through the inertial cost of project management resource which would need to be maintained pending such decision. We consider it likely that the delay and uncertainty would also manifest in higher risk premiums in contractor bids. It is also unlikely that time lost through such a pause could be made up, and therefore the earliest commissioning date would inevitably be delayed.
121. If it is deemed that options other than an immediate progression to commissioning are more likely, then it would be possible to reduce the scope of Stage 1, by deferring into Stage 2 any activities that are not primarily targeting information value for Stage 2 decisions. This would reduce the potential regret cost in the event of an alternative decision.

Transgrid's plan implicitly takes the position that Stage 2 delivery is the primary objective and is less consistent with a reading of the ISP in which Stage 1 is to provide information value for Stage 2 decisions

122. If the final AEMO 2022 ISP is considered to place primacy on early delivery, then Transgrid's Stage 1 plan is essentially consistent with this reading. A consequence of this reading is the need for the AEMO feedback loop to be as late as possible in order to take

²³ For example, the option 'pathways' are shown in Figure 31 of the Final 2022 ISP. We confirmed the assumed commissioning dates from this table and from information such as is shown in table 8 of the Final 2022 ISP, and AEMO confirmed to AER that we had correctly interpreted the assumed dates.

advantage of the best possible information, but not so late as to jeopardise delivery of Stage 2 by the current target commissioning date.

123. Our conclusions would change, however, if this reading was not AEMO's confirmed intention and if greater emphasis is placed on achieving 'information value' from Stage 1 to inform Stage 2 decisions. For example, in its Final 2022 ISP, AEMO states that '*a staged delivery provides protection against rising project costs*' and that '*(a) material increase in project costs will test the timing of the project and the rationale of the ODP²⁴.*' AEMO also states that '*(p)roject implementation (Stage 2) remains subject to the ISP feedback loop, which will assess whether the project remains aligned with the latest ISP prior to the final investment decision.*'
124. When considered with an information value and optionality objective more to the fore, we consider that the plan would place more emphasis on defining the information requirements for Stage 2 decisions and assessing the contingent implications of alternative paths arising from the defined decision points, such as we describe in section 4.2.3. We consider it likely, too, that the relevant decision points (such as the AEMO feedback loop) would be later in Stage 1, taking maximum advantage of the ability of the planned Stage 1 activities to provide mature information on cost, risk and feasible timing for Stage 2.
125. The implications of alternative paths beyond Stage 1 are unclear, but we expect that they could be costly, with significant potential implications also for project risk and timing. Should AEMO not confirm HumeLink as still actionable in its feedback loop assessment or deem it to be actionable but with deferred timing, then the 'maximum regret' will be the Stage 1 cost. Notwithstanding the lack of consideration in Transgrid's current plan, we consider that some form of information value plan could still be developed and could be usefully incorporated into Transgrid's Stage 1 project.

Transgrid's current total HumeLink project cost estimate is of a preliminary nature

126. Transgrid describes its cost estimate accuracy for HumeLink as Class 4, in accordance with the AACE International Recommended Practice and Estimate Classification, being that it is preliminary in nature for the purpose of a study or feasibility. This means that the project scope definition (or maturity) is low, being 1% to 15% of full project definition. The cost estimation accuracy for a Class 4 estimate can vary within a wide range, typically in the order of +/-30% (and up to +50%).
127. Transgrid states that its assessment of the risks in the Stage 1 CPA '*[have] been considered for each activity and associated cost using a qualitative approach to determining the mid-point (i.e. P50) estimate of the forecast costs.*'²⁵
128. Based on our understanding of the available information, and prior to engagement with the market for the largest component of the forecast capex, the cost estimate remains preliminary and we consider that Transgrid's characterisation of the current cost estimate range as 'Class 4' is reasonable.

Transgrid has not yet accounted for the likelihood that costs will be greater than its current estimate

129. Transgrid has not yet taken regard to the current and expected market conditions in preparing its full project cost forecast to date. The current project cost estimate of \$3.317bn was developed in 2021,²⁶ is expressed in \$2020-21 and has not included provision for real cost escalation other than its forecast at that time for labour costs.

²⁴ AEMO Final ISP, page 68. ODP is the Optimised Development Plan. In the 2022 ISP this plan includes HumeLink but with timing dependent on the 'market scenario'.

²⁵ Attachment A.1 HumeLink Stage (Early works) CPA Principal Application 5 April 2022, page 39

²⁶ Transgrid HumeLink PACR, July 2021, page 58

130. It is reasonable to expect that the project may be subject to material increases in cost from Transgrid's current estimate. In response to a recent information request,²⁷ Transgrid advises, for example, that in the year to around January/February 2022:
- The copper price increased 15%;
 - EU steel price increased by around 25%;
 - The aluminium price increased by 55%;
 - The oil price approximately doubled; and
 - The zinc price increased by 40%.
131. Transgrid also advised that, due to the tight market for transmission line workers, contractors have indicated that they may need to import workers, and which may result in further increases in their costs.
132. It appears inevitable that the HumeLink cost will be higher than Transgrid's current estimate. This places even greater onus on the need for Stage 1 works to be effective in determining a realistic cost estimate, together with a realistic assessment of the cost estimate range and taking advantage of all realistic opportunities to minimise the cost without jeopardising required outcomes.

Transgrid's Stage 1 scope has the potential to produce an efficient Stage 2 cost, albeit based on market conditions that appear to have already deteriorated

133. We consider that Transgrid's Stage 1 scope represents a reasonable approach to achieving an efficient cost for Stage 2. In particular, we consider that Transgrid's ECI process is a sound approach to achieving optimised design and specification as well as competitive pricing for Stage 2. However, it appears that this pricing will inevitably be relative to market conditions that have already deteriorated compared with the conditions at the time of Transgrid's current cost estimate and which may well deteriorate further.
134. Similarly, we consider that the significant Stage 1 up-front investments in land and environment processes and in community and stakeholder engagement, are likely to provide the best prospect of being able to proceed to construction without excessive risk or further delay.

Transgrid's targeted accuracy range for the total project cost estimate at the conclusion of Stage 1 appears reasonable

135. Cost estimation accuracy improves as the level of the project definition is increased. There is a trade-off between the requirement to invest in time and resources up front (and associated level of commitment to the market) and the expectation of a reduction to the expected range of outcomes and an associated improvement in cost estimation accuracy.
136. We expect that for an infrastructure project of this scale, a cost estimate approaching Class 2 following early works (and therefore at FID) would be a reasonable expectation for consumers. In some areas, such as for final compensation for land or environmental offset costs, there may be aspects of the cost that cannot be accurately determined until closer to the time. In broad terms, this means that at FID, the cost estimate should improve to a range approximating +/- 10%.
137. Given the current wide cost range, and significant negative impact that a cost towards the upper end of the current range would have to the net benefit of the project, we were surprised to find only limited recognition of this range in Transgrid's CPA and no explicit targets for improvement to the cost estimate range as outcomes from Stage 1.
138. Following feedback from stakeholders and our own enquiries, Transgrid did however provide information on its cost estimation uncertainty targets. Table 4.1 provides this information. In this table, Transgrid sets out the expected cost accuracy by capex category

²⁷ IR#004, EMCa questions, responded 13th July 2022

that Transgrid expects to achieve for Stage 2 CPA, following the completion of the Stage 1 (Early Works) capex.

Table 4.1: Expected cost accuracy from Stage 1 (Early Works) for Stage 2 capex

Category capex	Description	Expected class estimate for Stage 2 CPA	Transgrid's comments
Direct capex			
Procurement	Substations and transmission lines	Class 3/2	Striving for Class 2 but will be dependent on level of accuracy possible for high risk scope items which are part of the ECI procurement.
	Long-lead time equipment – Substation transformers and reactors	Class 2	Options to be exercised to secure slots to maintain program. Further design work to be completed to achieve class 2 accuracy
Land acquisitions	Acquisition costs	Class 3	Class 3 due to the anticipated number of compulsory acquisitions and variability in these numbers.
	Environmental 'offset' costs	Class 2	Class 2 due to timing of and inherent forecasting uncertainties related to how biodiversity offsets will be finalized and implemented.
Labour and indirect capex			
Project team resources	Labour and corporate support for project management, procurement, land and environmental activities	Class 2	Class 2 due to potential variability in project team requirements and turnover
Project development	Development, engineering, legal and economic support	Class 2	Class 2 due to variability in project team support requirements, including variable legal advisory costs.
Land and environment	Fees, labour and indirect costs	Class 2	Class 2 due to variability in land and easement support requirements based on number of complex and/or compulsory acquisitions
Procurement	N/A		Expected direct costs only

Source: Transgrid response to information request, Transgrid EUAA Humelink Stage 1 (Early Works) CPA 26 May 2022 sent to AER, Table 2

- 139. In response to questions from the EUAA, Transgrid advised that it is seeking to achieve Class 2 in most cases, particularly for those capex components that are subject to a market-tested procurement process. We consider that this is reasonable.
- 140. We consider that the Stage 1 (Early Works) activities that Transgrid has planned should facilitate identification and management of cost and delivery risks.

Implications of changing market conditions to delivery risk

- 141. In response to our information request, Transgrid stated that it is reviewing its delivery program in response to the final 2022 ISP which included a delivery date of July 2026 for HumeLink and which is 5-6 months earlier than the current schedule.

142. There is considerable generation and transmission development in Australia, and also significant investment in government and private sector infrastructure projects underway and planned. Transgrid described the risk of increasing lead times on deliveries of steel, conductors and long lead time equipment. The impact of this demand for labour/skilled resources, materials, plant and equipment is already being experienced in some industry sectors in Australia.
143. These factors increase the delivery time risk for the project. We consider that Transgrid’s Stage 1 scope provides a reasonable approach to mitigating risks of delay, including through the ECI process and through its plan to lock in production slots for long lead-time equipment. Deteriorating market conditions, even since the time of Transgrid’s CPA, will require that Transgrid utilises these and other mechanisms in order to maintain its focus on delivery.

4.3.3 Summary of findings on Transgrid’s proposed activities

144. Transgrid’s proposed Stage 1 activities are strongly oriented towards enabling delivery of the full HumeLink project within an ambitious timeframe. We consider that Transgrid’s plan represents a reasonable approach to achieving this objective.
145. We consider that Transgrid’s Stage 1 scope is also a reasonable approach to reducing cost uncertainty, identifying and providing the opportunity to mitigate Stage 2 project risk and working to contain overall HumeLink project costs to the extent that this is feasible.
146. Transgrid’s plan assumes that it will provide information to AEMO for its ‘feedback loop’ assessment around 9 months before the end of Stage 1. At that stage, Transgrid will not have completed all activities that will subsequently help to further firm up its cost estimate and reduce or manage Stage 2 risk and AEMO’s market benefit information will have only partially matured towards the positions that it will present in its 2024 ISP.
147. We consider that this timing is reasonable if it is assumed that the need to be able to transition directly from Stage 1 early works to Stage 2 construction is paramount. However, the lack of recognition of, and contingency planning for, alternative paths limits the potential for Stage 1 as currently proposed, to provide option value to better inform Stage 2 decisions and creates the potential for greater future regret.

4.4 Does the proposed capex allowance represent an efficient level of expenditure for the proposed activities in Transgrid’s plan?

4.4.1 Summary of Transgrid’s proposed capex forecast

148. Table 4.2 shows the proposed Stage 1 capex forecast of \$321.9 million proposed by Transgrid, and which it states is additional to the capex approved by the AER in its 2018-23 Revenue Determination.

Table 4.2: Stage 1 CPA capex (\$m, real 2017-18)

	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	Total
Actual	0.4	0.6	8.6	15.6	13.4	-	-	38.6
Forecast					31.2	188.9	63.2	283.3
Total capex	0.4	0.6	8.6	15.6	44.6	188.9	63.2	321.9

Source: Transgrid, A.1 HumeLink Stage (Early Works) CPA Principal Application 5 April 2022 Final, Table 8

149. The actual incurred capex is for the period ending 31 December 2021, for labour and indirect capex. The forecast capex includes additional resources and associated costs to 30 June 2024.
150. In Table 4.3, the total proposed Stage 1 capex is shown for each capex category.

Table 4.3: Stage 1 CPA capex by category (\$m, real 2017-18)

Category	Description	Proposed total capex (\$m, real 2018)
Direct capex		
Procurement	Steel tower assembly design and prototype testing	█
	Long-lead time equipment (LLE) – Substation transformers and reactors	█
	Pre- construction development – substation and transmission lines	█
Land acquisitions	Valuation and acquisition costs including options to acquire easements and acquiring a site for Gugaa substation, and cultural heritage	22.1
Labour and indirect capex		
Project team resources	Labour and corporate support for project management, procurement, land and environmental activities	75.5
Project development	Development, engineering, legal and economic support	32.9
Land and environment	Fees, labour and indirect costs	28.9
Procurement	Bidder payments	22.2
	Data room services and market road show	0.6
	Transaction procurement support	4.8
Community & stakeholder engagement	Stakeholder and community programs including social legacy, design and communication and community improvement	18.6
Regulatory approvals and other support costs	RIT-T and CPA activities including document preparation, modelling and commissioning expert reports	11.9
TOTAL proposed capex for Stage 1		321.9

Source: Transgrid, A.1 HumeLink Stage (Early Works) CPA Principal Application 5 April 2022 Final, Table 9

Direct capex components

151. The direct capex comprises two components, as shown in Table 4.3, and makes up 39% of the proposed Stage 1 capex:
- Firstly, procurement activities which Transgrid describes as being undertaken by the successful contractors at a cost allowance of \$104.6m. These activities include:
 - assembling, designing, erecting, and testing of nine standard steel towers;
 - procuring production slots for equipment with long lead times, in particular substation transformers and reactors; and
 - pre-construction development, including for substations and transmission lines, equipment specifications and identifying quantities of plant and materials required.
 - Secondly, the cost of acquiring land for a substation at Gugaa and transmission line easements at a cost of \$22.1m.

152. Transgrid has provided a copy of its procurement strategy including an overview of its Early Contractor Involvement (ECI) procurement process.

Labour and indirect capex components

153. The labour and indirect capex comprises six components with the associated costs shown in Table 4.3, making up the remaining 61% of the forecast capex:
- undertaking project management and corporate support (labour costs) for procurement, land and environmental activities;
 - undertaking project development activities, including engineering, legal and economic support;
 - undertaking land and environmental planning and approval activities, including environmental impact studies, surveys, preparing an Environmental Impact Statement (EIS), and specialist land agent support;
 - supporting the procurement process, including bidder payments and data room services;
 - consulting with stakeholders and the community (non-labour), including community support, social legacy, design and communication and community improvement; and
 - seeking necessary regulatory approvals – this includes actual costs for completing the RIT-T process as well as our actual and forecast capex for preparing our Stage 1 and Stage 2 Applications.

Capex forecasting methodology

154. Transgrid describes its capex forecasting methodology for Stage 1 (early works) capex as making use of the following techniques:²⁸
- external market-based quotations and valuations;
 - outcomes from the RIT-T process including stakeholder consultation and AER review;
 - benchmarks of similar projects, such as Project EnergyConnect;
 - bottom-up estimates based on recent actual costs; and
 - other industry market data and specialist advice.
155. Transgrid describes a three-step forecasting process applied to its bottom-up forecast comprising:
- Step 1 – Define the initial scope and identify the indicative costs;
 - Step 2 – Refine the initial scope and costs; and
 - Step 3 – Finalise the early works capex forecast.
156. We reviewed the application of the above techniques and process.

4.4.2 Our approach to assessment of Transgrid's proposed capex

157. For the purpose of our assessment of the proposed capex forecast, we have assumed the scope is as Transgrid has proposed. Specifically, we have made the working assumption that it involves the activities that Transgrid has described in its CPA. Our findings in relation to the proposed capex must therefore be read in the context of this working assumption.
158. We have considered Transgrid's:
- Descriptions of each element of proposed capex;
 - Estimation methodology; and
 - Consultants' reviews of its estimated costs.

²⁸ Attachment A.3 Capex forecasting methodology HumeLink Stage 1 (Early works) 5 April 2022

159. We have also 'sense checked' the forecast capex from our team's experience in developing and reviewing the cost estimates for transmission projects. This includes experience reviewing project cost estimates undertaken by TNSPs, including by Transgrid itself (for Project EnergyConnect).

4.4.3 Our assessment of Transgrid's cost estimation process

Transgrid has presented its CPA for Stage 1 as encompassing its costs to June 2024

160. As noted above, the actual incurred capex is for the period ending 31 December 2021 and relates to labour and indirect capex categories. Forecast capex includes additional resources and associated costs to 30 June 2024, and which includes the decision points of:
- AEMO feedback loop for Stage 2;
 - Stage 2 CPA, and AER's determination of same; and
 - Transgrid's FID for Stage 2.
161. The proposed Stage 1 early works program comprises a combination of direct capex and labour and indirect capex related activities. As discussed earlier in this report, a central component of its Stage 1 program is Transgrid's ECI procurement process to improve the cost accuracy and ensure that it is ready to commence construction as soon as possible after the approval of our Stage 2 CPA, to meet the proposed delivery target.

Proposed Stage 1 capex is within the AEMO feedback loop confirmation

162. The capex forecast for Stage 1 of \$321.9m is within the limit included in the confirmation from AEMO's feedback loop of \$327.6m.
163. Transgrid has also compared components of its cost estimate with other benchmarks including AEMO's Transmission Cost Database (TCD). Transgrid states that the costs included in the TCD are based on Class 5 estimates and are therefore not as accurate as cost estimates that it has developed.

Transgrid has applied a reasonable process for the development of its cost estimate

164. Transgrid has primarily built up its cost estimate through a bottom-up cost estimating process; for example, through estimating resource requirements and applying unit rates.
165. Transgrid has also provided evidence of external quotes and external advice that it has utilised in preparing its Stage 1 CPA and following our enquiry of Transgrid, provided additional explanatory information as to the basis for its assumptions in applying this information.
166. In addition, Transgrid has reviewed components of its forecast with cost items incurred for Project EnergyConnect, application of the AEMO TCD and employed a professional engineering firm, GHD, with experience in electricity transmission engineering to review Transgrid's cost estimate.
167. The procurement activities will be undertaken as part of a separable package (SP) of work, known as SP1, and must be completed prior to construction commencing. Construction will be undertaken in SP2 and is subject to the approval of the Stage 2 CPA and FID by the Transgrid Board.²⁹

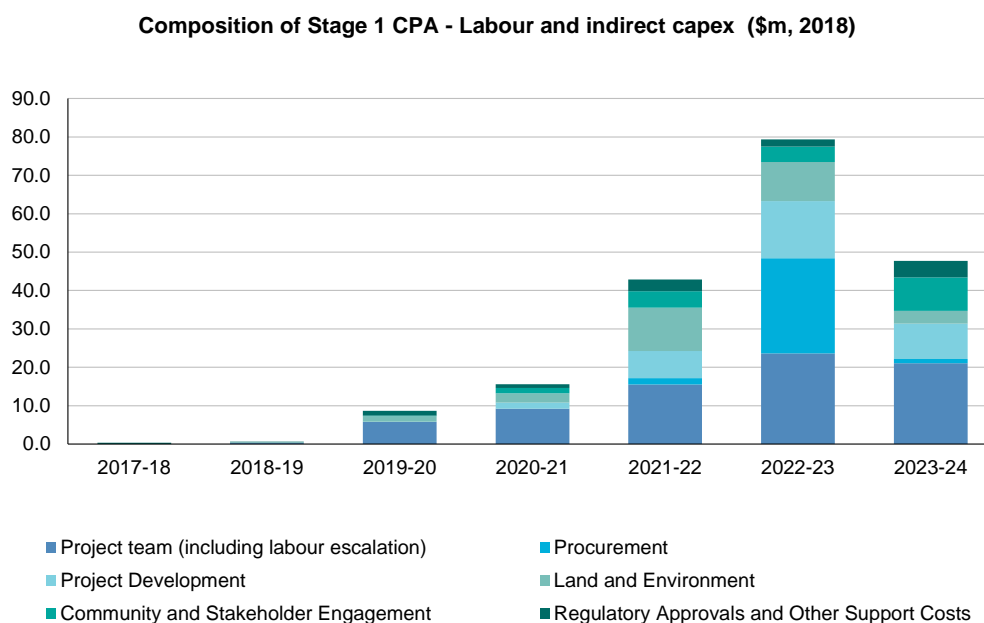
Review of the mobilisation of resources is reasonable

168. We have considered the expenditure forecast for the labour and indirect capex activities as an indication of the staging of related activities over the Stage 1 period, in Figure 4.3.³⁰

²⁹ Attachment A.1 HumeLink Stage (Early works) CPA Principal Application 5 April 2022

³⁰ We acknowledge that in response to our requests for information, Transgrid has identified an issue in the presentation of its program logic and has subsequently provided an update to its cost mapping and schedule. We have not been provided any updates to the expenditure profile, and understand that any changes do not alter the total capex forecast proposed for Stage 1.

Figure 4.3: Composition of stage 1 CPA – Labour and indirect capex



Source: EMCa analysis of Transgrid, A.7 – Labour and indirect cost model and Attachment A.3, Table 6-1

169. As shown in Figure 4.3 above, the project team is progressively established over the Stage 1 period. The major items of cost that contribute to the increase evident in 2022-23 compared with other years relate to:

- Procurement: inclusion of bidder costs; and
- Project development: EIS development and applications fees.

170. The build-up of costs appears consistent with the proposed activities to be completed within Stage 1 and the likely ramp-up of works described in Transgrid’s sequencing plan.

Transgrid engaged GHD to provide an expert verification of its costing, which GHD has endorsed

171. Transgrid engaged GHD to undertake an independent engineering verification and assessment of our Stage 1 capex forecast and the scope of our Stage 1 activities. GHD used various methods to assess Transgrid’s scope and capex forecast including:

- benchmarking based on AEMO’s Transmission Cost Data Base (TCD);
- reviewing of tender processes and documents;
- reviewing actual costs from comparable Transmission projects such as Project EnergyConnect; and
- assessing the reasonableness of the proposed Project team structures, scheduled hours and labour rates.

172. Overall, Transgrid states that:

‘GHD concluded that our Stage 1 (early works) costs are within a reasonable margin of its comparative estimates. GHD’s independent review therefore supports the consistency of our forecast capex with that which would be incurred by a prudent and efficient business.’

173. We consider that the review undertaken by GHD has been reasonable in scope for determining the robustness of the proposed capex by Transgrid, having considered each of the input assumptions applied. The review provides additional assurance that the cost is reasonable.

4.4.4 Our assessment of the components of Transgrid’s proposed capex

174. We have presented our assessment of the components of Transgrid’s proposed capex forecast for each of the categories of capex that it has proposed, as presented in Table 4.3.

Direct capex - procurement

175. The direct capex of \$104.6m for procurement represents 32% of the forecast stage 1 capex comprising the activities of:

- Steel tower assembly design and prototype testing [REDACTED];
- Long-lead time equipment (LLE) – Substation transformers and reactors [REDACTED]; and
- Pre-construction development – substation [REDACTED] and transmission lines [REDACTED].

176. These activities will be undertaken by the appointed contractors following the ECI procurement process.

A competitive process is currently occurring for early works procurement activities

177. Transgrid states that by December 2023, contracts will be awarded to the successful tenderers who will undertake all of the procurement activities identified in its Stage 1 direct capex forecast.

178. These activities will be undertaken as separable packages (SP) where:³¹

- SP1 includes contractor project management, detailed design including site surveys, design coordination with suppliers, management plans and documentation including CEMP, stakeholder engagement, resource, construction and procurement planning, tower steel design including prototype and load testing, transformer and reactor design and slot booking.
- SP2 includes the remainder of the works outside SP1 including full procurement activities, remainder of detailed design, site establishment (compounds, camps etc), construction and commissioning.

179. SP1 includes activities up to 30 June 2024 and SP2 includes activities from 30 June 2024.

180. The program shows that SP2 is awarded as part of Stage 1, however remains conditional on Stage 2 approval by the AER and FID being achieved.³²

Forecast capex for materials based on supplier quotations

181. Transgrid has sourced quotations from two suppliers for steel for transmission towers and for the LLE:

- the supply of steel which includes the assembly design, erection and testing of standard tower designs. Forecast capex is based on further detailed pricing from the lowest cost steel supplier for prototype tower testing.
- total estimated equipment cost is based on actual costs for equivalent plant for Project EnergyConnect and QNI at a cost of \$92.1m. The forecast capex is based on an assumed deposit and booking fee of 20%.

182. A booking fee of 20% is at the top end of the range of quotations from suppliers that varies [REDACTED]

183. We asked Transgrid to clarify the basis of its assumed value of 20%.³³

‘It is Transgrid’s commercial position that the EPC Contractors are best placed to take contractual responsibility for all aspects of the engineering, procurement and construction of HumeLink. This includes the final specification, supplier selection and

³¹ Transgrid’s response to information request IR04

³² Transgrid’s response to information request IR04

³³ Transgrid’s response to information request IR04

placing of orders for long lead equipment and materials, which EPC Contractors routinely manage. This ensures total responsibility and accountability for delivery lies with the construction contractors, who are best able to manage design, logistics and supply chain for all aspects of the project.'

184. As the booking fee is a percentage of the total cost, where the total cost is determined following a market-tested process, the delivered price for the LLE should not be negatively affected. We consider that Transgrid's commercial position to transfer contractual responsibility to the EPC contractor is reasonable in this circumstance, and that a higher percentage as advised by the manufacturers is not unreasonable.

Sequencing of activities clarified to confirm that procurement capex follows completion of ECI process

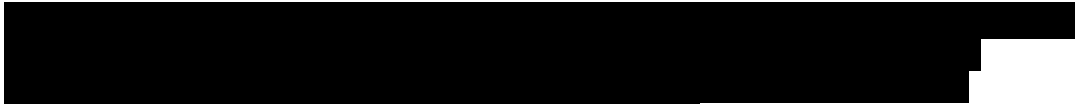
185. Transgrid has updated the phasing of the activities in this capex category to more accurately reflect when the expenditure will be incurred.

'While the dollars accurately reflected the total cost of the detailed design/procurement activity, we agree we got the phasing wrong. The costs occur between Jan-2024 - June 2024.'

'All the procurement capex activities listed in Table 4-1 (document A.3) occur after the completion of the ECI process. These include steel tower prototype testing, long-lead time equipment and pre-construction development'

Pre-construction costs are based on reasonable benchmarks

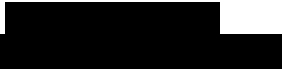
186. Transgrid has used benchmark costs from other similar transmission projects to determine a percentage of pre-construction costs that could be expected to reasonable apply to the HumeLink project. The pre-construction costs assume a total EPC project cost of \$1,376m for transmission lines, and \$470m for substations. The review undertaken by GHD determined that the estimate of transmission line and substation costs represents a reasonable basis upon which to estimate pre-construction costs.³⁴

187.  The review undertaken by GHD considered similar benchmarks at a component level and overall and this provides additional assurance that the approach is reasonable.

188. We were initially concerned about potential duplication of activities included in Transgrid's capex forecast, across several components and of the sequencing of work occurring earlier than would otherwise be expected. The clarifications of detailed design and of the sequencing of procurement activities described above have addressed these concerns.

Direct capex - Land acquisitions

189. The direct capex of \$22.1m for land acquisitions represents 7% of the forecast stage 1 capex and comprises the property acquisition costs of the new Gugaa substation, negotiation of option agreements for the acquisition of land and easements, complying with Property Acquisition NSW Guidelines and if necessary, making provision for compulsory acquisitions.

190. Transgrid has developed bottom-up estimates for these components based on a combination of valuation techniques and allowances. For example, 

³⁴ Attachment A.8 GHD Independent Engineering verification HumeLink Stage 1 (early works) 5 April 2022

191. Transgrid has applied the Acquisition Compensation Principles for NSW Major Projects with updated assumptions based on its most recent experience for PEC. [REDACTED] Transgrid has also applied quotations to components of the cost where available.
192. In general, GHD's independent estimate was similar to or higher than that included by Transgrid, and on that basis GHD concluded that Transgrid's cost methodology was reasonable.
193. Based on our enquiry of the process applied by Transgrid and taking account of its most recent experience and GHD's review, we consider that the capex forecast for Stage 1 has been prepared on a reasonable basis.

Labour and related costs – project team resources

194. The labour and related costs of \$75.5m for project team resources represent 23% of the forecast stage 1 capex. This comprises expenditure for project management, procurement, community and stakeholder engagement, land and environment, and core business engineering support.
195. Twenty-seven percent (\$20.7m) of the proposed expenditure has been already incurred, with \$9m for project management and development.
196. We have reviewed the assumptions on resourcing and the unit costs associated with each resource included as part of the bottom-up estimate and they appear to have a reasonable basis. Our initial concerns relating to potential overlap of scope and roles particularly with Transgrid's allowance for pre-construction development, have been addressed by Transgrid, as noted above.
197. From a top-down perspective, the cost benchmarks reasonably based on the comparisons undertaken by GHD.

Indirect capex - Project development

198. The indirect capex of \$32.9m for project development represents 10% of the forecast Stage 1 capex. This is for external legal, engineers and other consultants to carry out activities to complete the Stage 1 activities.
199. The largest components are associated with legal costs for land acquisitions, contracts and other general legal support and geo-tech and survey costs to enable contractor's to more accurately price foundation costs and assess the risk of varying geotechnical conditions. The costs have been developed by a combination of quotations, and with reference to similar work and/or unit rates on PEC.
200. We were initially concerned about potential duplication of activities included in Transgrid's capex forecast, across several components and of the sequencing of work occurring earlier than would otherwise be expected. The clarifications of detailed design and of the sequencing of procurement activities described above have addressed these concerns.
201. We are satisfied that these works are in addition to those described in other categories of capex and that Transgrid has undertaken a reasonable process to determine its cost estimate supported by 'bottom up' evidence.

Indirect capex - Land and environment

202. The indirect capex of \$28.9m for land and environment represents 9% of the forecast Stage 1 capex. This comprises activities for the Environmental Impact Statement (EIS) development and application and land agent fees.
203. A significant component of the proposed expenditure has been already incurred. The remaining components are supported by bottom-up evidence, including external quotes with rates and schedules against required work scopes, and calculation of the required EIS application fee.
204. The proposed amount appears reasonable.

Indirect capex – Procurement

205. The indirect capex of \$27.6m for procurement represents 9% of the forecast stage 1 capex. This component is for:
- Bidder payments;
 - Data room services and market road show; and
 - Transaction procurement support.
206. We observe that the ECI and procurement timeline³⁵ included in Transgrid's CPA refers to the number of assumed contractors at each stage leading up to contract award in December 2023. [REDACTED] related to the assumed number of 3-5 contractors in its CPA, and which suggested to us that a smaller number of losing bidders and corresponding lower payment would suffice.
207. [REDACTED]
208. The bidder payment figure is supported by advice from Pro Squared Infrastructure Consultants. According to GHD's review, the payment is consistent with NSW Government policy and with bidder payments made on PEC, after accounting for differences in the scope of work.
209. [REDACTED]
210. We consider that the investment required by tenderers in the context of competition for top-tier contractors to participate in the process requires that reasonable costs are reimbursed to unsuccessful parties. Successful parties will likely include some provision for recovery of the associated development costs in winning the work in their final costs. We are satisfied that the information provided by Transgrid adequately supports the basis of the proposed capex, and that the amount is reasonable.
211. We consider that the procurement support services and transaction costs are required as a part of the ECI procurement process, and that the associated costs are reasonable.

Indirect capex – Community and stakeholder engagement

212. The indirect capex of \$18.6m for community and stakeholder engagement represents 6% of the forecast stage 1 capex. This is for activities required of the RIT-T process including landholder and community engagement plans and events, indigenous engagement plan, social legacy plan and EIS engagement plan. The largest components are associated with community engagement and social legacy initiatives:
- [REDACTED]
 - Social legacy initiatives are described as being at an 'early stage', but GHD notes that the provision brings the total allowance for Community and stakeholder engagement into line with its benchmark.
213. Based on the requirements of this project being similar to other major infrastructure projects and GHD's own review of available benchmarks, we consider that the capex is reasonable.

Indirect capex - Regulatory approvals

214. The indirect capex of \$11.9m for regulatory approvals represents 4% of the forecast stage 1 capex. This comprises management of activities through RIT-T stages, CPA submissions (one for each stage), AEMO feedback loop submission activities required to support FID.

³⁵ Attachment A.3 capex forecasting methodology HumeLink Stage 1 (early works) 5 April 2022, Figure 1

- 215. The proposed capex includes Stage 1 CPA, RIT-T (PSCR, PADR, PACR) costs already incurred of \$4.0m to December 2021. The forecast capex is based on bottom-up costing with external quotations. Other components are adequately described, with the basis for the costing provided.
- 216. Based on the requirements of this project being similar to other major infrastructure projects and GHD's own review of available benchmarks, we consider that the forecast capex is reasonable.

4.4.5 Summary of findings on Transgrid's proposed capex allowance for the set of proposed activities

- 217. We have reviewed TransGrid's cost estimating process used to derive the costs for the components included for the activities proposed in Stage 1, including the proposed delivery method and the review and evidence provided in support of the forecast cost.
- 218. We consider that Transgrid's cost estimate for Stage 1 is adequately supported by a combination of verifiable quotations, benchmark costs from other Transgrid projects (notably PEC) and advice from its advisors. We consider that the GHD review of Transgrid's costing, provides reasonable additional assurance that the cost is reasonable. Both Transgrid's costing and GHD's review are at a suitably granular level to facilitate our checks.
- 219. In summary, we consider that the cost methodology that Transgrid has applied is reasonable and is likely to result in a reasonable estimate of the required capex for Stage 1.

APPENDIX A – INFORMATION SOURCES

A.1 Transgrid’s CPA

Figure A.1: Documents and models comprising Transgrid’s CPA

Document /model number	Name	Content/purpose
A.1	HumeLink - Stage 1 (early works) Contingent Project Application - Principal Application document	Seeks the AER’s approval to amend the forecast capex allowance in the 2018-23 Revenue Determination and the revenue requirements and MAR for the 2023–28 regulatory period based on Stage 1 (early works) costs.
A.1A	HumeLink Stage 1 2018–23 Post Tax revenue Model (PTRM)	Demonstrates the calculations of our incremental revenue requirements and MAR for the 2018–23 regulatory period, based on Stage 1 (early works) costs
A.1B	HumeLink Stage 1 2023–28 Post Tax revenue Model (PTRM)	Demonstrates the calculations of our incremental revenue requirements and MAR for the 2023–28 regulatory period, based on Stage 1 (early works) costs
A.1C	HumeLink Stage 1 2018–23 Roll-forward Model (RFM)	Rolls forward the Regulatory Asset Base (RAB) and Tax Asset Base (TAB) across the 2018–23 regulatory period, inclusive of Stage 1 (early works) costs
A.1D	HumeLink Stage 1 2018–23 Depreciation Model	Calculates forecast depreciation based on as commissioned capex over the 2018–23 capex, inclusive of Stage 1 (early works) costs
A.2	Scope definition document	Overviews the scope of our Stage 1 (early works) activities. It also presents the basis on which the works have been efficiently scheduled to: <ul style="list-style-type: none"> determine the prudent and efficient construction cost for Stage 2 identify, explore and manage our project risks, and meet the 2026-27 target date in the ISP.
A.3	Capex forecasting methodology	Explains and justifies our Stage 1 (early works) capex including: <ul style="list-style-type: none"> summarising the nature and scope of Stage 1 activities the methodologies we have used to determined our forecast capex, and how we have verified and validated our capex forecast
A.4	Labour and indirect costs	Explains the bottom-up forecast of labour and indirect support costs required for the development and approvals work, management of the early works program, and overall project management.
A.5	Capex forecast model	This model forecasts capex by regulatory asset class and year to 2023-24, sourcing inputs from the Direct Non-Labour Cost Model and the Labour and Indirect Cost Model and applying labour cost escalation and inflation where appropriate
A.6	Direct non-labour model	This model builds up the procurement and land acquisition costs that input to the Capex Forecast Model
A.7	Labour and indirect cost model	This model builds up the labour and indirect costs (including procurement, project development, community and stakeholder engagement, land and environment, regulatory approvals and other support costs) that inputs to the Capex Forecast Model

A.7a	Indirect Costs Artefacts 1	This spreadsheet contains the artefacts that support the cost build up for procurement, project development and land acquisition indirect costs
A.7b	Indirect Costs Artefacts 2	This spreadsheet contains the artefacts that support the cost build up for environmental impact, community stakeholder engagement and regulatory approval indirect costs
A.8	GHD Advisory Independent capex Review	An independent assessment of the scope, procurement process and forecast capex for Stage 1 (early works).

Source: Transgrid CPA, Figure A.1

220. Transgrid published the documents above as part of its CPA. However, in some cases, Transgrid also had ‘confidential’ versions and we were provided with these.

A.2 Other relevant documents

A.2.1 Transgrid RIT-T, PACR

221. We accessed and, where relevant, took account of information in prior Transgrid documents from its RIT-T process, as listed in Figure A.2.

Figure A.2: Relevant RIT-T information

<p>HumeLink RIT-T information</p> <ul style="list-style-type: none"> • <i>Transgrid: Reinforcing the NSW Southern Shared Network to increase transfer capacity to demand centres (HumeLink); Project Assessment Conclusions Report (PACR), 29 July 2021</i> • <i>Transgrid: HumeLink PACR addendum report, 17 December 2021</i> • <i>EY: Reinforcing the NSW Southern Shared Network PACR, 29 July 2021</i> • <i>Various models relating to the PACR, including EY market modelling for different scenarios and Houston Kemp NPV models relating to the PACR and to the PACR Addendum</i>
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Source: Published by Transgrid

A.2.2 AEMO ISP

222. We list the key relevant ISP information that we considered, in Figure A.3.

Figure A.3: Relevant ISP information

AEMO ISP information most relevant to HumeLink assessment

- Draft 2022 Integrated System Plan (ISP) (December 2021)
 - Associated documents and models including in particular:
 - Appendix 5: Network Investments
 - Appendix 6: Cost Benefit Analysis
- (Final) 2022 Integrated System _Plan, published 30 June 2022
 - Associated documents and models as for Draft

Source: AEMO website

APPENDIX B – TRANSMISSION PLANNING, CURRENT REGULATORY ARRANGEMENTS AND TRANSGRID’S TRANSMISSION DEVELOPMENT PLANS

B.1 Industry in transition

B.1.1 Transmission investment and the transition to renewables and storage

223. In keeping with electricity systems globally, the National Electricity Market (NEM) is experiencing a significant transition away from reliance on thermal generation towards renewable generation and storage. As a result, the location of these energy sources is also shifting to be more geographically distributed and diverse. This will require a substantial investment in transmission infrastructure to enable connection of these new technologies and to facilitate benefits for consumers by way of a lower cost of electricity.
224. Major transmission investment is required to facilitate Australia’s energy transition in line with the Australian Energy Market Operator’s (AEMO) Integrated System Plan (ISP) and beyond. Further, jurisdictions are identifying and planning Renewable Energy Zones (REZs), with major transmission required to support and bring this energy to consumers.

B.1.2 The evolving transmission planning, access and regulatory framework

225. At the same time, there has been a move to centralise certain elements of planning of the energy system. Examples of this shift to centralised planning include the development of the ISP by AEMO, and establishment of jurisdictional specific planning arrangements, particularly in relation to the development of REZs, to meet renewable energy targets.³⁶ Additional planning and regulatory mechanisms, and changes to the mechanisms described above, may also result from implementing the federal government’s announced policy of ‘rewiring the nation’ to support the continued transition to renewables.
226. In this context, the Energy Security Board (ESB) has commenced work on transmission access reform for the NEM, with a view to facilitating connection of ‘*new generators and storage in places that facilitate the full benefit of all these resources coming into the national power system*’.³⁷ We summarise the issues that the ESB review seeks to address and its relevance to our assessment of the current RIT-T project, in section B.2.2.
227. We recognise the importance of the energy transition, and the role of all participants including the network service providers including Transgrid. We have necessarily undertaken our review in accordance with the current planning and regulatory framework. Nevertheless, to the extent that ‘market benefit’-related projects rely on future assessments, it is necessary to consider the likelihood of continuing changes to technologies and changes to the regulatory and planning framework that affect justification for projects of this type.

B.1.3 Taking account of uncertainty

228. Given the factors described above, and the reality that transmission projects tend to be both lumpy and capital-intensive, it is particularly necessary to consider option value in assessing major transmission projects. Considerations of option value and the timeframe over which

³⁶ AEMC Consultation paper, TPI Review, 19 August 2021, page 9

³⁷ Energy Security Board, Transmission access reform, Consultation paper, May 2022, page 5

market benefits are adequately able to be modelled, can help to ensure that any transmission investment is prudent and efficient in accordance with the regulatory objectives. This in turn helps in meeting the objective of ensuring that consumers do not end up paying the risk costs of transmission projects that are developed earlier than required or which become stranded or ‘regretted’ due to changes in the electricity market and the technologies deployed there.

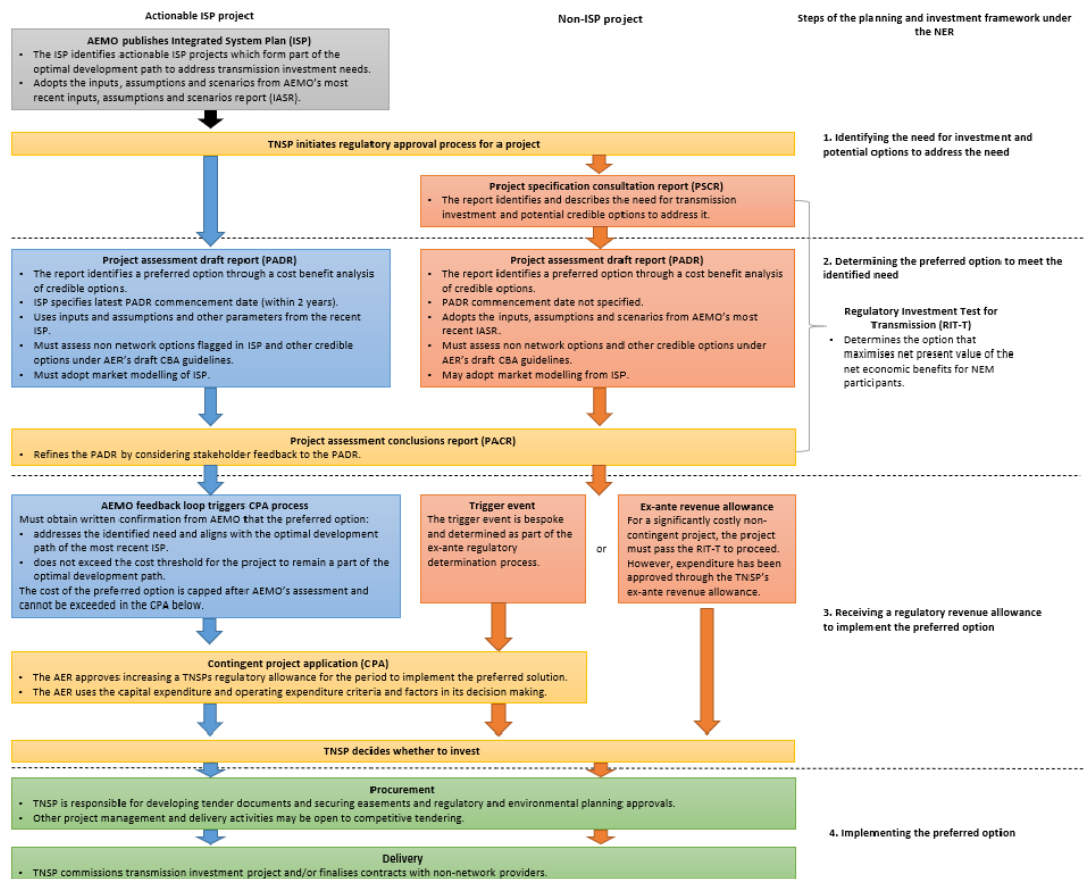
229. While we have taken the factors above into account in our assessment, we also caution that our assessment of the proposed RIT-T project is of this project alone. No inference from our assessment of this project should be drawn on the need for or benefit of transmission projects generally or their role in facilitating the transition to renewables.

B.2 Current regulatory arrangements

B.2.1 Overview of planning and investment framework

230. The current regulatory arrangements provide for TNSPs to invest in the transmission network to promote the long-term interest of consumers. This is achieved by an independent regulator, the AER regulating revenues and prices. An overview of the planning framework is provided in Figure B.1 below.

Figure B.1: Overview of key steps in the transmission planning and investment framework



Source: AEMC, Consultation paper transmission planning and investment review

231. TNSPs are regulated on an ex-ante basis, with the governing National Electricity Rules (NER) requiring the determination of a revenue cap, being the result of a building block assessment. The components of the building block model include providing for a return on and return of capital, and which requires the AER to determine a prudent and efficient level

of capital expenditure (referred to as the capital expenditure allowance) for each regulatory control period.

232. TNSPs are also subject to efficiency schemes to encourage efficient investment in capital expenditure, the benefits of which are shared with consumers.
233. In addition to the determination of a capital expenditure allowance as part of the regulatory determination cycle for each Regulatory Control Period (RCP), TNSPs are provided with a 'contingent project' mechanism. Contingent projects are significant network augmentation projects that may arise during a regulatory control period, but the need, timing and/or cost of the project is uncertain. As such, project costs are not provided for in expenditure forecasts for a regulatory control period. Rather, contingent projects are linked to specific investment drivers, which are defined by a 'trigger event'. When a trigger event occurs, the proponent is able to submit a CPA to seek an increase to the revenue allowance to fund the project.
234. The NER requires also that transmission projects that have a capital expenditure above a pre-determined cost threshold are also subject to the requirements of the Regulatory Investment Test for Transmission (RIT-T). The cost threshold is currently \$6 million.

B.2.2 Current reviews will provide additional guidance

235. There are two key reviews currently underway that will provide important guidance to the market and regulatory bodies and which seek to address some immediate issues facing the industry transition.

AEMC review of Transmission planning and investment

236. The AEMC has initiated a review of the transmission planning and investment framework to (i) identify issues with the existing regulatory frameworks in relation to the timely and efficient delivery of major transmission projects, (ii) explore options for reform of or improvements to the existing regulatory frameworks, and (iii) recommend possible changes to the National Electricity Rules (NER) and other regulatory instruments (if required) to support frameworks that are fit-for-purpose and promote the timely and efficient delivery of transmission services.³⁸

237. The AEMC describes the objective of the review as:³⁹

'..to ensure that the regulatory frameworks strike an appropriate balance between requiring rigorous assessment, to mitigate the risk of inefficient transmission investment, and the need to facilitate timely investments that deliver beneficial outcomes. Consumers will be paying for these projects for decades into the future and it is therefore important that they are in the long term interest of consumers. As such, it is imperative that the regulatory framework for assessing and approving them remains fit-for-purpose.'

238. Amongst the reasons for this review given in the consultation paper, the AEMC states:⁴⁰

'The magnitude of anticipated investment brings into focus the need for the regulatory framework to accommodate the substantial investment and effectively manage the uncertainty of the transition, as such major discrete projects have a greater degree of uncertainty than business-as-usual (BAU) transmission investment. For the purposes of this consultation paper, the Commission considers major transmission projects to be projects of a significant size, scale and scope such that they are associated with greater uncertainty relative to BAU investments. These can be ISP or non-ISP projects.'

³⁸ AEMC Consultation paper, TPI Review, 19 August 2021, page 1

³⁹ AEMC Consultation paper, TPI Review, 19 August 2021, page 2

⁴⁰ AEMC Consultation paper, TPI Review, 19 August 2021, page 2

ESB review of congestion management

239. National Cabinet has instructed the ESB to progress detailed design work on transmission access reform and to propose a rule change to Energy Ministers by December 2022.⁴¹
240. The ESB initiated a project to:⁴² (i) address the problems that prompted National Cabinet to ask the ESB to conduct the review, namely, the problems associated with the current access regime; (ii) work with stakeholders to understand their concerns and respond to them where appropriate, including by considering alternative mechanisms proposed by stakeholders, and (iii) ensure sufficient flexibility for jurisdictional differences.
241. The latest deliverable from this project is a consultation paper to seek feedback on four model options to guide the design of solutions for congestion management.
242. The ESB describes the current arrangements for provision of transmission access as follows:⁴³

'The NEM has a transmission access regime whereby parties may connect to the grid at any point (subject to meeting technical requirements) and fund only the cost of the assets required to connect to the shared grid. Generators are not required to contribute towards the cost of the shared transmission network, and they receive no assurance that the transmission network will be capable of transporting their output to load centres.'

243. Amongst the reasons provided in the consultation paper for this project, the ESB states:⁴⁴

'The energy transition can be delivered more cheaply and quickly if new generators and storage connect in places that facilitate the full benefit of all these resources coming into the national power system.'

In some cases, generators are connecting in locations where, a lot of the time, they are not adding new renewable energy to the power system. Instead, they are displacing the existing renewable generators. If we don't change the access regime, we are likely to end up with a larger generation and storage fleet and transmission network than necessary to achieve the same decarbonisation and reliability outcomes (see Figure 1).

These issues are being recognised by some State governments who have sought to progress reforms to implement renewable energy zones (REZ) within their regions. The work of the Energy Security Board (ESB) aims to support and dovetail with these initiatives.'

B.3 Transgrid's RIT-T projects in the context of its other planned projects

244. Our reading of Transgrid's RP is that due to the uncertainty associated with major augmentation projects, Transgrid has included many of its major transmission projects as contingent projects:⁴⁵
- '...so that customers only pay for them if and when they proceed. The costs of these contingent projects are not included in our capex forecast and are therefore not reflected in our forecast revenues or prices.'*
245. We understand Transgrid has included two categories of contingent projects:⁴⁶

⁴¹ ESB consultation paper Transmission access reform Consultation paper, page 8

⁴² ESB consultation paper Transmission access reform Consultation paper, page 8

⁴³ ESB consultation paper Transmission access reform Consultation paper, page 15

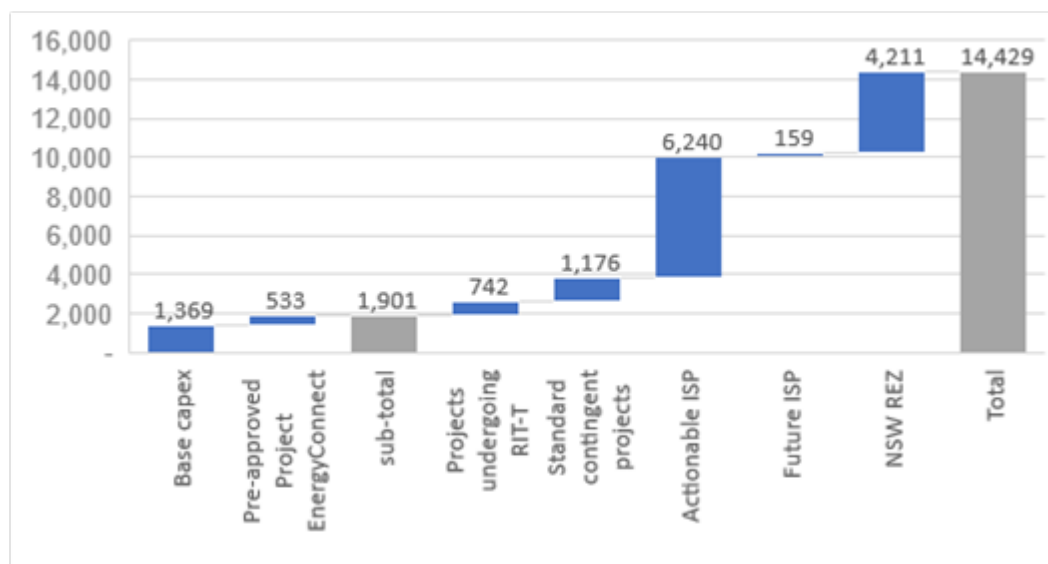
⁴⁴ ESB consultation paper Transmission access reform Consultation paper, page 5

⁴⁵ Transgrid 2023-28 Revenue Proposal, page 163

⁴⁶ Transgrid 2023-28 Revenue Proposal, page 163

- Projects undergoing a RIT-T (comprising four projects that have an indicative cost in the 2023-28 regulatory period of \$741.9 million and a total estimated cost of \$792.2 million.)
 - Standard contingent projects (eight projects that have an indicative cost in the 2023-28 regulatory period of \$1,175.9 million and a total estimated cost of \$2,142.3 million.)
246. In addition to the contingent projects, a number of additional actionable projects are nominated in the Integrated System Plan (ISP) published by AEMO. The ISP is principally an engineering assessment that determines the least cost combination of network and supply side resources to meet forecast demand within the parameters of government policy. It is used to trigger transmission investment, whereas the market is relied upon to deliver generation investment. Importantly, the ISP identifies an investment need with potential market benefits, not a preferred solution.
247. Transgrid has separately identified this tranche of additional projects in its Revenue Proposal. A further tranche of projects is also flagged associated with implementing Renewable Energy Zones in NSW.
248. As shown in Figure B.2: below, collectively this has the potential for \$14billion of capital investment within the next 5 years. This is far in excess of the \$1.9billion currently proposed in Transgrid's main regulatory submission.

Figure B.2: Total planned capex, including contingent ISP and NSW REZ projects, \$m 2022-23



249. The energy transition has been and is expected to be rapid. Whilst it is appropriate for TNSPs to be guided by the assumptions included in the ISP and other sources, and to plan and engage with local communities at a regional level, this does not insulate them from change. Accordingly, regular and ongoing review of market changes is required to build option value and minimise regret cost.
250. It remains critical that TNSPs continues analysis to ensure the right transmission investment projects proceed through the further regulatory and investment processes and are ultimately in the long-term interests of consumers. This is premised on full transparency to ensure that risk is not unreasonably transferred to consumers.

APPENDIX C – SUMMARY OF PROJECT SCOPE AND COST COMPONENTS WITH TRANSGRID’S ANNOTATION OF DRIVERS

Figure C.1: Project scope and cost components against primary and secondary driver

Category	Description	Drivers (as described by Transgrid)		Cost (\$m)	EMCa observations
		Primary	Secondary		
Procurement	Steel tower assembly design and prototype testing	Timing	N/A	[REDACTED]	Primarily will contribute to deliverability assurance, as claimed by Transgrid. May also contribute to reducing cost uncertainty and risk, though at the expense of reducing optionality.
	Long-lead time equipment (LLE) – Substation transformers and reactors	Timing	Cost, risk		
	Pre- construction development – substation and transmission lines	Timing	Cost, risk		
Land acquisitions	Valuation and acquisition costs including options to acquire easements and acquiring a site for Gugaa substation, and cultural heritage	Timing	Cost, risk	22.12	Primarily will contribute to deliverability assurance, as claimed by Transgrid. Will also contribute to reducing cost and risk, but at the expenses of reduced optionality.
Project team resources	Labour and corporate support for project management, procurement, land and environmental activities	Cost	Risk, timing	75.45	To the extent that this supports procurement and land acquisition categories as above, a material proportion of this cost is for activities to support deliverability assurance
Procurement	Bidder payments	Cost, risk, timing	N/A	22.22	Primarily will contribute to continuous improvement through potential for cost reduction. Also improved optionality through better cost and risk information.
	Data room services and market road show	Cost, risk, timing	N/A	0.56	
	Transaction procurement support	Cost, risk, timing	N/A	4.78	
Project development	Development, engineering, legal and economic support	Cost, risk, timing	N/A	32.86	Supports continuous improvement (in terms of cost and risk), deliverability assurance and optionality through better cost and risk information.
Land and environment	Fees, labour and indirect costs	Cost, risk, timing	N/A	28.85	As above
Community & stakeholder engagement	Stakeholder and community programs including social legacy2, design and communication and community improvement	Risk	N/A	18.56	As above
Regulatory approvals and other support costs	RIT-T and CPA activities including document preparation, modelling and commissioning expert reports	N/A (overhead)	N/A	11.9	Primarily supports optionality, through better informed decision making for Stage 2
TOTAL proposed for Stage 1				321.89	